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To Sir J. Fayrer from Author

CLINICAL LECTURES

ON

DISEASES OF BONE.

BY

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PREFACE.

THESE Lectures were delivered from time to time to the Students of the Westminster Hospital. My object was to explain to my class the nature and course of the various morbid conditions occurring in the living structures referred to, and then sketch their rational treatment.

The present series treats only of diseases of bone. Some of these Lectures have appeared in the "Lancet," others in the "Indian Medical Gazette," the remainder are now published for the first time. All have been subjected to correction and revision.

I have to return my very best thanks to my colleague, MR. A. PEARCE GOULD, not only for his valuable assistance in the wards of the Hospital, but also for carrying these pages through the press. I am also under a debt of gratitude to my former pupil, MR. J. L. JAQUET, for the drawings, and the ready assistance he has afforded me in preparing these Lectures.

C. MACNAMARA.

13 GROSVENOR STREET,
October, 1878.

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CLINICAL LECTURES.

LECTURE I.

REMARKS ON THE DEVELOPMENT AND ANATOMY OF BONE.

GENTLEMEN, — Before entering on the more immediate subject of these lectures, I must briefly refer to some points connected with the development of bone.

Rindfleisch remarks that, in the formation of the osseous system, "when a cartilaginous epiphysis has reached a certain bulk, medullary spaces containing bloodvessels appear exactly in its centre, and this gives the necessary impulse to the development of true bone, which accordingly begins at this very point." Doubtless, as far as it goes, this is a true statement of the case; but the question is, where does the medulla come from, and how does it happen that it appears exactly in the centre of the cartilage? I believe, if we examine carefully injected specimens, we shall arrive at the conclusion that bone is not produced from cartilage, unless the part has previously been occupied by medulla; and until the cartilage has been pierced by channels through which blood circulates, medulla never makes its appearance. I need hardly remark that there is a time in the life of every human being when his skeleton consists of nothing but cartilage, and if these parts were to continue to grow, men would have cartilaginous and not osseous skeletons. For the process of growth, in the strict sense of the term, implies that no change takes place in the material form or composition of the growing body, so that you will comprehend my meaning when I say it is incorrect to talk about bone growing from temporary cartilage; the two structures differ essentially, not only in their anatomical, but also in their chemical composition, and I repeat that bone never developes except from medulla, and, again, medulla cannot be produced except from cartilage which has been permeated by bloodvessels. This is true not only as regards the original centres from which ossification commences in fœtal cartilage, but also in the case of growing bones and in the pathological changes which occur in consequence of disease. Under these various circumstances we invariably find that when and where the cartilage has been permeated by bloodvessels, the nuclei of the cartilage cells multiply rapidly, and medulla replaces the original cartilage. In these specimens that I show you, the nuclei of the cartilage cells may be seen passing into the cancellous spaces of the newly-formed bone, where some of them seem to undergo transformation into the small round cells of the medulla, and others continue to exist in a cluster producing the myeloid cells of growing bone. (*See page 5*).

But you will observe, that before the medulla can be formed there must be actual contact between the blood and cartilage cells; for it is obvious, in the case of fœtal cartilage and also in a growing bone, that something more than the permeation of the cartilage by the serum of the blood is necessary for the formation of medulla; if such were not the case, the medulla would sprout up throughout the entire cartilagenous skeleton and not form definite points in its centre. The living and growing cartilage is nourished by a constant stream of serum passing through its substance from the surrounding vessels, but it is not until these vessels have extended into the cartilage, carrying with them living blood-cells, that medulla makes its appearance in the manner I have described; and I conceive it is mainly by their joint action—I might say through the fertilization of the cartilage by blood-cells—that medulla is produced.

On the other hand, during the formation of bone from temporary cartilage, it is quite possible that some of the cartilage cells entering the trabecular spaces, as they unquestionably do at the line of ossification, may remain there as cartilage cells simply mixed with the corpuscles, fat-cells, and so on, of the medulla. Without attempting to determine which of these ideas is the correct one, it is sufficient for our purpose to know that bone is formed from cartilage cells and their descendants, contained in the medulla, endosteum, and periosteum; these cells under certain circumstances surround themselves with a soft hyaline material, which, as it increases in quantity separates the nuclei of the original cells from one another. While this process is going on, the nucleus secretes bone-earth into its surrounding hyaline material, and so each cell becomes encased in a shell; in other words, it is converted into a bone corpuscle, and so hard bone is constructed by the living particles of cartilage cells in somewhat the same manner as coral is formed by minute anthozoa.

This is no matter of speculation, for if we look at these specimens which have been decalcified we find at the line of ossification a number of indentations in the cartilage, into which capillary vessels are prolonged from those in the cancellated tissue of the bone; the surrounding cartilage cells are rapidly proliferating and their nuclei may be seen passing into the indentations where they are transformed into the small round cells of the medulla, and so the spaces in the cancellated tissues of the bone are produced at the expense of the temporary cartilage (Fig. 1). But you will observe that in the walls of the newly constituted spaces lacunæ and canaliculi (bone cells) are forming; the cells of the medulla are there seen in various stages of transformation, passing from the round cell into bone cells, the living

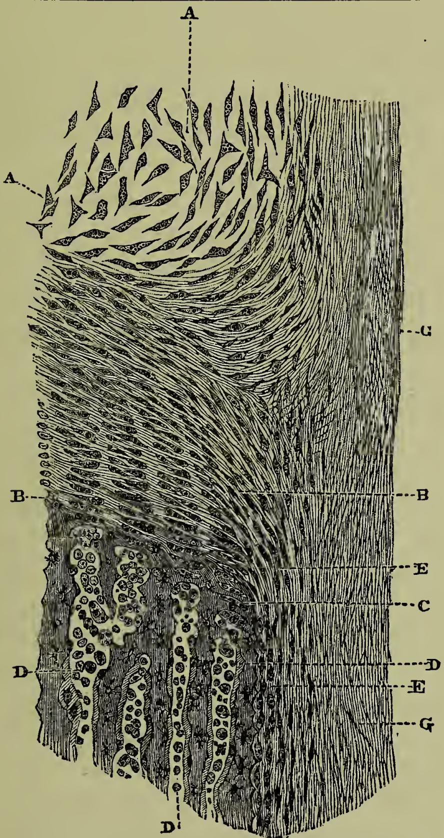

FIG. 1. Section of epiphyses through line of growing bone and periosteum.

A A, Cartilage cells. Some of them are seen to be undergoing fibroid changes.

B B, Cartilage cells rapidly proliferating and arranging themselves into rows continuous with the medullary spaces in the newly formed bone.

D D, Nuclei of cartilage cells passing into the medullary spaces of the bone; along the sides of these spaces some of the round cells are seen to be transforming themselves into bone corpuscles.

C C, Cartilage cells passing into and forming the deep layers of the periosteum. Some of these cells are undergoing changes into bone corpuscles,

E E, The inner layers of the periosteum.

G G, The outer layers of the periosteum.

nucleus of the cell surrounding itself with a hyaline material, into which it subsequently secretes bone earth. As layer upon layer of the medulla ossifies in this way, the trabeculæ increase in bulk and strength.

Whilst the bones are thus augmented in length at the expense of the epiphysial cartilage they are also becoming thicker through the action of cells contained in the periosteum. Let us take, for example, the femur of a young child, and we find that its condyles are composed of cartilage, the periosteum being continued from the shaft of the bone over the cartilage (Fig. 1), and on examination we find that the outer layers of the cartilage have assumed a fibroid character. Imbedded in the fibres are a number of the original cartilage cells—in fact this is the way in which the periosteum is formed; it is nothing less than a fibrocartilage manufactured out of temporary cartilage from which the shaft of the bone is also produced. You therefore perceive that as the shaft of the bone is increasing in length at the expense of the central portion of the temporary cartilage, the outer layers of this same cartilage with its cells is being transformed into fibro-cellular tissue, and the bone advances into this covering like a finger thrust into a glove. As the bone grows in length, however, this covering is constantly being produced, for you clearly understand that the newly formed fibro-cellular tissue encasing the bone contains living cells of identically the same nature as that from which we have seen the shaft of the bone to be constructed; so that the circumference of a long bone is augmented as layer upon layer of the cells derived from the temporary cartilage ossifies, in precisely the same way as the trabeculæ are increased in thickness from the action of the round cells of the medulla. It is a mistake to draw a hard and fast line between the deep layers of the periosteum and the shaft of the bone, the one structure merges into that of the other, the cellular layers of the periosteum are as much a part of the bone as the medulla.

If we examine specimens of carefully injected diseased cartilage, we frequently observe changes such as I have noticed in progress. Under abnormal conditions blood passages sometimes stretch into the epiphysial cartilage, either from vessels in the bone or the surrounding soft structures; and along the course of these blood-channels, and especially at their termination, the cartilage cells are converted into medulla, which in its turn is transformed into osseous tissue, and so we not unfrequently meet with isolated patches of bone in the middle of a mass of temporary cartilage.

It is not necessary for me to occupy your time with a detailed account of the minute anatomy of bone, but I must refer briefly to one or two points which, from a surgical point of view, are of importance to us.

The extremities of the long bones are surrounded by a thin layer of compact osseous tissue, but the bulk of the spongy portion of these bones is constructed of a number of trabeculæ, the spaces between them being filled up with soft structures (medulla), which play the most important part in the various forms of disease we shall have to consider. With the aid of preparations made by soaking sections of injected bones in various agents which stain the tissues, I shall be able to explain to you the anatomy of the soft material filling the spaces in the spongy portions of the long bones. And let me here remark that these soft tissues are continuous with those occupying the medullary canal, and they also abut on the attached surface of the articular cartilages, filling more space in the spongy portion of bones than the osseous trabeculæ.

The greater number of vessels passing into the extremities of the long bones are derived from vessels perforating the periosteum and outer thin layer of bone, and not from the nutrient artery, for instance, the vessels of the lower end of this femur have been injected from the popliteal artery. This anatomical arrangement of the vessels will in some measure explain the fact, that in certain cases well-regulated and continuously applied pressure round the lower end of the femur may influence inflammatory changes going on in the bone, the blood-supply to its spongy tissue being thus materially affected. In fact, if we smear a thick layer of extract of belladonna and mercurial ointment over the skin covering the condyles of the femur and knee-joint, and encase the whole in well-applied splints and strapping, we should place inflamed intra-osseous structures in much the same condition with reference to their supply of blood, as the iris is in after the pupil has been fully dilated with atropine for the cure of iritis. The volume of blood circulating in the bone would be restricted, and the part kept at rest—two important elements in the successful treatment of inflammation; and I need hardly observe that the same remark applies to other parts in which the interior of the bones are filled with medulla supplied with blood from the vessels in the surrounding soft structures, and which can be compressed by means of strapping.

If we examine the soft structure in the cancellated tissue, we shall discover that it is fairly well supplied with blood—many of the smaller vessels course along the walls of the trabeculæ while others stretch across the intra-trabecular spaces; the smaller arteries pass into larger thin-walled blood-spaces, much the same as we see in the cavernous splenic veins. If cinnabar or other insoluble colouring matter is injected into the veins, it is taken up by a considerable number of the cells in the medulla of bone, but not by cartilage cells or by the giant-cells and small round cells of the medulla, the latter, as I have explained to you, being the descendants of temporary cartilage cells and directly concerned in the formation, growth, and repair of the osseous structure.

In addition to these vessels, the spaces in the cancellated structure and the medullary canal of the long bones contain a network of adenoid or cytogenic tissue, continuous with that of the endosteum, its meshes being filled with a vast number of corpuscles which histologically, as well as functionally, resemble those contained in the spleen. In fœtal, and in fact in all bones until about the fifteenth year of age, the marrow is of a deep red colour, and it continues so in the bones of the trunk and cranium, while in those of the limbs large quantities of fat cells appear in the meshes of the adenoid tissue and the medulla consequently becomes of a yellow colour. Authorities hold that this plexus of adenoid tissue is the commencement of the lymphatics in bones. It seems to me that in the medullary canal the evidence in favour of this view is strong, and I think we may yet demonstrate the existence of lymphatic structures in this situation, but however this may be, we certainly find that the Haversian canals and the spaces in the cancellated structure of bone contain a network of adenoid tissue in addition to their vessels, and these structures play an important part in inflammatory and other abnormal processes going on in the interior of the long bones.

If we examine these sections of the articular surface of the tibia which have been rendered transparent by glycerine, we shall be able to comprehend the anatomy of the cancellated structures immediately beneath the articular cartilages. The soft materials filling the cancelli project down to within about the 0·10 of a line of the attached surface of the cartilage, the medulla there terminating in bulb-like masses, from which processes branch out, unite, and form a series of arches beneath the cartilage. So numerous are these channels proceeding from the medullary spaces to the cartilage that the layer of compact bone they perforate may be said to be riddled with tortuous passages, and this lamina would therefore be a weak point in the bone were it not for a peculiar arrangement of its calcareous elements.

With a half-inch magnifying power we can see a number of concretions (shells, if you prefer the term), enclosing cartilage cells, as well as a quantity of granular earthy matter dispersed in an irregular manner in the osseous lamina, between the cartilage and the cancellated structure. There is no constant system of Haversian canals or lacunæ in this dense hard lamina, but the canals I have described pass from the medullary spaces up towards the cartilage through this calcareous layer, which, from its peculiar construction is capable of resisting inflammatory or other abnormal action going on in the joints, or external parts; while changes occurring in the medullary substance are apt to pass along the contents of the canals above referred to, to the attached surface of the cartilage; in fact, the vitality of the articular cartilages mainly depends upon the supply of blood contained in the medulla, as that of the cornea does upon the surrounding vessels.

As an illustration in point we may refer to this specimen, taken from the body of a woman who died from the effects of inflammation of the veins of her right thigh. At the time of her admission into the hospital, the cellular tissue of her thigh and buttock was literally infiltrated with pus; the femur was in places denuded of periosteum, and the knee-joint distended with putrid matter. The patient died from septic poisoning, and after death we found a large fibrinous clot occupying the right side of her heart, and extending for some distance along the pulmonary arteries.

But what we have specially to concern ourselves with is the condition of the lower articular end of the femur, which during life had been macerating for some time in the warm putrid pus contained in the knee-joint. Destructive changes had been set up in the cartilage covering the articular surface of the femur, and the end of the bone laid bare. If we examine a section of the denuded bone we notice that the disease going on in the knee-joint has not affected either the subcartilaginous lamina of bone or the contents of the processes of medullary matter which it contains; illustrating the fact, that under certain circumstances of acute affection of the joints, the important elements enclosed within the cancellated tissue of the adjacent long bones may be protected from destructive changes, by means of the dense osseous layer which is situated beneath the articular cartilage.

If, in the case now under consideration, the disease in the joint had continued for some time longer, it is probable that the hyperaction would have extended to the medulla contained in the subcartilaginous lamina of bone, and then, a number of the round cells (cartilage) which it contains would have been thrown into increased action, a quantity of new bone would have been formed, into which, from hyperæmia of the vessels, an excess of bone earth would have been secreted, and a layer of dense sclerosed osseous tissue would have been formed between the diseased joint, and the contents of the cancellated structure of the bone.

We may gain some practical hints from a consideration of the circumstances of the subcartilaginous layer of bone, for so long as this lamina remains, it is almost impossible for bony anchylosis to occur between the extremities of contiguous bones.

In a considerable number of specimens of chronic inflammation of the cancellated tissue of the long bones, I find the calcareous lamina and the trabeculæ in the cancellated tissue of the ends of the bone much thickened, so that the medullary structure of one bone has been effectually separated from that of the other bone entering into the formation of the joint. Under these conditions bony anchylosis is almost impossible; but if the structures intervening between the bone-forming material on both sides of the joint is removed, either by the hand of the surgeon or by means of disease, then bony or fibrous anchylosis may occur according to the proximity of the bones and the amount of motion which takes place between them. It is the existence of this subcartilaginous layer of bone that is apt to prevent the cure of many cases of joint disease by anchylosis.

In excising a joint in cases of the kind we not unfrequently have to leave portions of unhealthy osseous tissue behind ; nevertheless anchylosis now occurs between the ends of bones which had previously been in apposition for months without union, because the medullæ of the bones entering into the formation of the joint are brought into apposition. In fact, it is evident, supposing the cancellated tissues of two bones are separated by means of the subcartilaginous layer, that their articular extremities can no more unite than if they were separated by a plate of mica.

I have already remarked that, in cases of chronic inflammation, sclerosis of the bone is likely to occur behind the calcareous lamina from hyperaction of the medulla, and so the bone-forming material or medulla is separated from the joint, not only by the subcartilaginous lamina, but also by means of new bone beneath it. The same thing occurs in instances of ununited fractures; the medulla in the cancellated structure of the ends of the bones ossifies, and effectually prevents the bone-forming elements from one end of the fracture uniting with those of the other, and so repairing the injury. If we wish to overcome this difficulty we must carefully remove the whole of the sclerosed ends of the bones and bring the healthy medullæ of the fragments into apposition, and if we then keep the parts properly at rest we may fairly expect union to occur; but neither pegs inserted into the sclerosed ends of the bone nor any other mechanical contrivance can effectually bring about the union of an ununited fracture, unless we remove the obstacle which separates the medullary structures of the ends of the bone from coming into contact with one another and growing together.

Those of you who have been attending the wards of the hospital will have seen cases in which the principles referred to in this lecture have guided us in practice; for in instances of disease both of the ankle and knee-joint occurring in adults, by means of free drainage and the removal of the articular surfaces of the bones involved, recovery by anchylosis from extensive disease has resulted. Among children, or before the epiphyses have become ossified, as no subcartilaginous layer of bone has formed, we may often preserve joints and the diseased ends of bones by means of free drainage alone, and keeping the ends of the cartilages at rest in accurate and continued apposition.

LECTURE II.

OSTEO-MYELITIS (ACUTE AND CHRONIC), ACUTE PERIOSTITIS, AND EPIPHYSITIS.

GENTLEMEN,—I wish to direct your attention to-day, first, to the subject of osteo-myelitis, or inflammation of the contents of the medullary and Haversian canals, including the spaces in the spongy portion of the long bones; and, secondly, briefly to consider the effects produced by this form of disease as contrasted with that caused by suppurative periostitis.

Osteo-myelitis may be either acute or chronic in its course: except as a complication following operations or injuries of the long bones the acute form of the disease is not often met with in this country. On the other hand, chronic affections of the contents of the spongy portions of various bones is a fertile source of mischief, not only to the osseous tissue, but also to joints situated in the proximity of the diseased bones.

You are aware that in the soft tissues of the body the materials arising from the process of inflammation are, as a rule, prevented from entering the blood by the contraction and plugging of the vessels surrounding the inflamed area, and also by the new cell formation which occurs in the part effectually preventing the absorption of putrid materials. And there can be no doubt that in instances of chronic ostitis the Haversian canals and medullary spaces surrounding the affected area become occluded; nevertheless, the formation of the vascular system in bone is eminently adapted for the absorption into the circulation of putrid matter formed in it, for, as I have before explained (p. 9), the smaller vessels contained in the medulla open directly into blood spaces very similar to the cavernous splenic veins, and hence in practice we find that, over and above the death of the bone resulting from acute osteo-myelitis, the patient runs a great risk from the absorption of putrid matter into the circulation, and consequently of pyæmia.

Professor Longmore has drawn special attention to the fact that after trivial gunshot injuries involving the periosteum, acute inflammation of the contents of the medullary canal sometimes occurs, followed by the death of the patient from septicæmia. But Sir J. Fayrer has without doubt done more to elucidate the clinical history of osteo-myelitis than any other living authority, a large portion of his experience, like my own, having been acquired in Calcutta and other parts of India where osteo-myelitis and pyæmia are more frequently met with than in this country. In fact, some ten years ago it was rather the exception than otherwise not to have osteo-myelitis among our hospital patients in Calcutta after amputations or compound fractures of the extremities. It is true that stricter attention having been paid to the sanitary condition of these institutions, and in my own practice, after the introduction of the antiseptic system of dressing we lost fewer cases from pyæmia. This improvement was partly due to other than atmospherical influences, because cases of ostitis and septicæmia sometimes occur without the admission of air into the inflamed parts—for instance, after injuries to the skull where no breach of continuity of the scalp has taken place, I have seen the most rapid and deadly septic poisoning supervene; but, as I said before, the carbolised spray and antiseptic dressing have, I believe, saved the lives of a considerable number of the patients in the hospital to which I was formerly attached.

It does not seem to me that there is any great difficulty in diagnosing a case of acute osteomyelitis, especially if the disease follows an injury to the bone. The patient under these circumstances may appear to be doing well for the first week or ten days after the accident or operation: the stump or wound, as the case may be, appears to be in a satisfactory condition, there is no deep-seated pain or external inflammation; but the patient's temperature rises suddenly, and he complains of severe and repeated rigors, followed by profuse perspiration; his tongue becomes dry and brown, the pulse and breathing rapid, and the skin and conjunctiva assume a dull, yellowish appearance; the face is haggard; general bodily and almost always great mental depression exist, with headache, often painless diarrhœa, and moderate enlargement of the spleen; the temperature of the patient's body rises and falls suddenly within the course of a few hours. But remember you cannot depend either on the temperature chart, rigors, or any other symptom alone, as indicating the existence of pyæmia, you must study the combination of symptoms to enable you to arrive at a correct conclusion on the subject.

I need hardly remark that the features presented by a case of septic poisoning differ from those of ordinary surgical fever, which usually supervenes some twelve or sixteen hours after an operation; the patient's eye being bright and glistening, his face and forehead are flushed, the skin feeling healthy to the touch, though hot and dry; in fact, the difference between pyæmia and surgical fever is as distinct as that between any two members of the same family can well be, although it is not always easy to describe their characteristic features in words. The more closely, however, you watch these fevers at the bedside the clearer will their respective peculiarities dawn upon you, and enable you without hesitation to give an opinion as to the nature of the fever from which your patient is suffering

Supposing the symptoms in a case of injury to one of the bones point to septic poisoning, it is still quite possible the putrid matter may be absorbed from a collection of pus situated in the soft parts round the end of the bone, or it may be that only limited necrosis exists. To satisfy ourselves on these matters it will be necessary to expose the injured bone, and this should be done without any unnecessary delay. If inflammation of the medulla exists, in place of the end of the bone presenting a healthy appearance it will be of a dark brown or black colour, unless in the very early stages of the disease, when the medulla will protrude as a fungating mass from the end of the bone. On passing a probe into the cancellated tissue or the medullary canal, we shall find that it is denuded of its lining membrane, and a thin bloody discharge usually containing air bubbles exudes along the side of the probe. The bone is, in fact, dead or necrosed, and the medullary tissue not only in the central canal, but in the cancellated and Haversian spaces for some distance from the site of injury, is in a state of putrefaction. It is the absorption of this putrid matter into the system which gives rise to the symptoms of septic poisoning from which our patient is suffering.

Under these circumstances, Sir J. Fayrer insists that the best chance we have of saving our patient's life is to amputate, or re-amputate the limb, as the case may be, at or above the next joint; if, for instance, the tibia is involved, amputate at the knee joint or through the lower end of the femur; and I quite agree with him as to the necessity of this line of practice, for it is only by the entire removal of the diseased bone, that is, the source from which the putrid matter is being absorbed into the blood, that we can hope to preserve the patient's life.

The question naturally occurs not only as to the site at which re-amputation is to be performed in cases of this kind, but also when the operation should be undertaken, for it is no small responsibility to take upon ourselves to propose, for instance, shortly after excising a knee or elbow, a further amputation of the limb at the hip or shoulder joint.

From this specimen—one among many—you will understand the necessity that exists in these cases for removing the entire length of a bone affected with osteo-myelitis, in order that the system may be preserved from poisonous infection from the suppurating medulla. In this instance the condyles of the femur had been excised for disease of the knee-joint, pyæmia supervened, and the ends of the bone having been exposed its cancellated tissue was discovered to be full of dead and rotting medulla. The surgeon in charge of the case decided to amputate the limb about half way up the thigh, and having divided the bone the contents of the medullary canal seemed to be healthy. After cutting through the bone and allowing it to soak in glycerine, however, several small cavities—or abscesses, as they are inaccurately called—in the medulla, are seen extending from the inflamed lower extremity of the femur up to the point at which amputation was performed, and probably existed in that portion of the femur which was not taken away, for the patient after the operation continued to suffer from, and ultimately died of, pyæmia. The small cavities to be seen in the medulla of this femur are produced by the formation of clots of blood in the vessels which supplied the diseased area of the medulla, and the subsequent death or necrosis of small areas of medulla. The same thing occurs under similar conditions in the lungs, and sometimes in other organs of the body. The formation of emboli, in instances of this description, is the result of the absorption into the veins of the products of putrefaction engendered in the rotting medulla contained in the cancellated tissue, absorbed, I say, by the veins; because in the instances of osteo-myelitis which have come under my notice, after resection of the knee or elbow joints, the medulla on the near, and not on the distant side of the divided bones has always been the site of these spots of necrosed medulla.

I believe we may lay down this law as to the time for amputation or re-amputation in osteo-myelitis; that the sooner an operation of the kind is performed the better. After rigors and the other symptoms indicating pyæmia have commenced, and the injured end of the bone has been discovered to be inflamed, osteo-myelitis, and its result pyæmia having declared itself, by far the best prospect we have of saving the patient's life is to remove the whole of the affected bone. There are, of course, exceptions to this as to every other rule. For instance, we had a case not long since in the H. Hoare ward, of a primary amputation through the leg for injury of the foot; all progressed favourably until the sixth day after the operation, when the patient was seized with violent rigors followed by profound collapse, like that of a person in the algid stage of Asiatic cholera, his temperature rapidly falling from 104° to 96°, and rising as quickly to 107°. This, however, was evidently an instance of pure septicæmia and not one of pyæmia. At the post-mortem examination a large clot was found extending from the right side of the heart into the pulmonary vessels, a by no means uncommon phenomenon in cases of septicæmia. In this instance it was out of our power to re-amputate, for had we done so we ran the risk of the patient's dying on the operating table. But instances of this description are rare in comparison with those of osteo-myelitis, in which, after the first rigour has passed off, the patient's condition improves for a time, and then, if the other symptoms of pyæmia are unmistakeably present is the moment most favourable for an operation; if taken advantage of before serious lung or other complications have manifested themselves, it affords infinitely the best, and generally the only, chance we have of preserving our patient's life.

But, as I have before remarked, you are not to suppose that acute osteo-myelitis only occurs in cases of direct accident or injury to the osseous tissue; for, as Mr. Savory and other authorities have observed, the exposure of a limb to sudden extremes of heat and cold, such as plunging the legs and feet into ice-cold or very warm water, may set up acute ostitis in the part exposed to treatment of this kind.

Numerous experiments have been made upon the lower animals with the object of solving the problem as to the manner in which cold induces inflammation of the tissues exposed to its influence, and although the question is still an open one, it seems tolerably well ascertained that cold acts as an irritant, and so causes changes in the bloodvessels of the affected part. The vessels of the skin, but especially those contained in the muscles are at first contracted; but very soon, particularly under the influence of extreme cold there is a vascular relaxation, and the blood pours from the internal parts, such as the medulla, into the congested muscles, and thus a deep impression is made on the nutritive changes occurring in the medulla, the effects of which are apparent in the condition of a patient under my care in Luke ward, and the notes of whose case were carefully kept for me by my dresser, Mr. G. T. Trewman.

W. S., aged ten, was admitted into the Westminster Hospital, February 8th. The patient's father and mother are strong, well-to-do country people; there is no suspicion of any hereditary disease in this case, and our patient, though slim, has been a healthy boy up to the present time. He was perfectly well until December 20th, when, on his way home from school he fell through the ice into a pool of water, and got his feet and legs wet. In this condition he returned to his cottage. The weather was very cold at the time, and in the evening his legs became extremely painful, and his mother, thinking he had rheumatism, applied hot poultices to his limbs. The patient has since been confined to his bed; his legs became much swollen; after some three weeks two abscesses burst in front of the right shin, and subsequently another formed over the ankle-joint, and discharged a small quantity of matter. The skin inflamed over the left foot in a similar manner. The patient was seen in January by Mr. T. Eager, of Woking, and, by his direction, removed as soon as practicable to the hospital.

On admission we found that the right leg and foot were pale, swollen, and very œdematous, with three ulcers along the shin and over the ankle-joint; there was no discharge from these sores, but on passing a probe through the upper ones, we came down upon soft disintegrated bone; the instrument could be thrust deeply into the dead bone. The left foot was affected in the same way. Our patient was much emaciated, with a dull jaundiced eye, dry brown tongue, a small very rapid pulse, and respiration 42 in the minute. His skin felt clammy, and was covered at times by profuse perspiration, the temperature of his body rising and falling rapidly from 101° to 105°. There could be no doubt as to his being under the influence of septic poisoning, arising in all probability from the absorption of matter from the dead tibia.

I could not obtain permission to remove the limb until the 15th of February, when the leg was amputated at the knee-joint. The patient suffered from diarrhœa after the operation, and it was with some difficulty we managed to control the purging; but, with this exception, he has improved rapidly in health, and is now convalescent.

In passing, let me warn you not to think lightly of diarrhœa in cases of pyæmia or to foster the notion that purging of this kind is an effort of nature to eliminate the poison from the system. My experience leads me to think that the intestinal catarrh with enlargement of the intestinal follicles and mesenteric glands met with in almost all cases of pyæmia, requires as much care in its treatment as the diarrhœa of enteric fever, and that it must be kept under by means of opium and quinine. I believe that these drugs, but especially the quinine in full doses is often invaluable in the treatment of pyæmia; we ordered W. S. six grains of quinine and three of Dover's powder, three times a day.

In this case the characteristic symptoms of acute osteo-myelitis were well marked. After exposure to severe cold the boy complained of deep-seated pain in the lower limbs, followed by inflammation and fever. Had appropriate treatment been then employed it is quite possible the parts might have resumed their normal functions, but the hot poultices in which the boy's legs were enveloped directly increased the mischief by augmenting the flow of blood into the superficial vessels, and thus adding to the disease already excited in the part. The right leg subsequently became swollen, extremely painful, and high fever supervened, pus formed along the limb, and pyæmia too plainly indicated the absorption of putrid matter into the system. The extensive necrosis of the tibia existing on the admission of the patient into the hospital, left us in no doubt as to the nature of the affection we had to deal with.

But I would draw your attention to the condition of the amputated limb. The tibia I show you was taken from the leg immediately after it had been removed from the body, and it has since undergone no maceration or preparation of any kind, and you observe its cancellated structure and medullary canal are entirely destroyed. It looks just like a bit of worm-eaten wood. The outer shell of bone is more healthy than any other part of the tibia, and is covered with periosteum from which in places a considerable quantity of new bone has been produced. All this mischief has been the work of less than seven weeks' disease. The patient was suffering from severe pain in the knee-joint before the operation, but as I then found the cartilages of the lower end of the femur were healthy, although there was pus in the joint, I amputated through the articulation, for I consider it to be a matter of considerable practical importance, if possible, to cut through a joint rather than open the cancellated tissues of one of the long bones, and evidently from the nature of the disease in this case, there was no particular tendency for the osteo-myelitis to extend from one bone to another, so that I felt it to be a decided advantage to leave the end of the femur intact.

As a rule, it seems to me the lungs are more frequently the site of the hæmorrhagic infarcts of pyæmia from diseased bone, than the tissues removed only a short distance from the original source of the pyæmic poisoning. It is generally supposed that emboli appear conspicuously in the lungs because of the equilibrium of the pressure existing in the arterial and venous circulation in these organs; but I believe that in pyæmia the whole of the blood in the body is charged with a deleterious agent which, whether vital or chemical in its nature, is directly influenced by free oxygen, and meeting with an abundant supply of oxygen in the air cells of the lungs, emboli are formed in the vessels, and necrosis of the pulmonary tissues, the so-called metastatic abscesses of septico-pyæmia result.

If you examine the lower end of the tibia and astragalus taken from W. S.'s leg, you see there is a large isolated cavity in the end of the tibia which was the site of an abscess. The periosteum covering this portion of the bone and that over the astragalus is, as you observe, comparatively healthy. Beneath the cartilage of the upper surface of the astragalus there is another cavity, and a similar collection of pus has formed in the cancellated tissue of the bone, and, passing forwards, burst into the astragalo-scaphoid articulation. These are certainly not metastatic abscesses, but doubtless arising from the same cause as that which induced all this disease in the tibia. But I would call your special attention to the deep red patch of cancellated tissue beneath the cartilage lining the lower surface of the bone; you may notice that it is surrounded by apparently healthy osseous tissue, the patch itself being a spot of highly-inflamed bone. I have examined sections of the part under the microscope in the fresh state, and it affords us a good example of the earliest stage of the process, which, after continuing for a time, has led to the abscesses above referred to in the astragalus, and which has reduced the tibia to the necrosed condition in which you now see it.

Osteo-myelitis by no means always runs the rapid course illustrated by the case of S——, for in the next bed to his there is a patient, H. T——, whose os calcis I excised. The bone is covered with healthy periosteum, but in its centre there is a cavity as large as the top of one's little finger, and from this, leading down to the lower surface of the bone, is a passage through which the products of the inflamed tissues found their way, but, meeting with resistance from the dense structures covering the heel the matter had forced a passage up along the exterior of the bone, and burst through the skin on either side of the foot.

H. T. was sent up by Dr. Ferris of Uxbridge, and placed under my care in this hospital on the 2nd of March. Some four years ago, after having taken an unusually long walk he was seized during the evening with violent deep-seated pain in his right heel. His impression at the time was that he had sprained his foot, but however this may have been, he suffered from more or less constant pain which always increased towards night. His foot was swollen, and he could not bear the slightest pressure upon the heel. After being confined to his room for some months, these symptoms gradually subsided, but the pain soon returned, and he continued to suffer more or less for upwards of twelve months, when an abscess burst on the inner and under part of his foot, and gave exit to some matter. This seems to have relieved the pain, but the discharge has since continued both from the original and fresh sinuses which have formed on the inner side of the heel.

H. T. came under my care after suffering in this way for four years. He was then unable to put his right heel to the ground; the soft structures covering it were swollen, and there was a constant discharge from various sinuses on the inner side of his foot. On passing a probe down upon the os calcis I could not discover any bare bone. Under these circumstances I made an exploratory incision into the soft parts, and found a small opening through the lower surface of the bone leading to a cavity in the centre of its cancellated tissue, and I therefore removed the whole of the os calcis with the exception of a thin slice along its upper and anterior articular surfaces. From the time of the operation H. T's health greatly improved. The sinuses healed, and new bone has partly replaced that which I removed, so that he has resumed his occupation, and does not even require the aid of a high-heeled boot to enable him to walk about.

You will observe that the cavity in this os calcis contains no dead bone, and further, that its walls are lined with a compact layer of osseous structure, corresponding to the walls of a chronic abscess of the soft parts of the body. This layer of bone is dense (sclerosed), so much so as to be of ivory hardness, formed not only by bone produced from the surrounding medulla by a process of slow petrifaction as it were, but a portion of the walls of this abscess are lined by a thin layer of hard bone, formed from an ingrowth of the periosteum into the cavity. Processes of this bone-producing membrane have inserted themselves along the sides of the abscess, like ivy clinging to an old wall, and so this lining layer of bone has been formed; its lacunæ and canaliculi run parallel to the free surface of the membrane, as they do beneath the periosteum of the shaft of one of the long bones. But if, in place of opening externally, as the collection of matter had done in this case, the abscess had been so situated that the direction of least resistance for the pus to have taken had been into a joint, the result would have been to excite changes in the part resulting in the destruction of the articulation. And this is doubtless the history of some cases of joint disease; or, in other words, chronic ostitis, though by no means always ending in abscess, may terminate in partial disintegration of the bone and destruction of a neighbouring joint.

On the other hand, it is quite possible that chronic inflammation occurring in the cancellated tissue of bone, may pass off without leading to further mischief in the part than a certain amount of enlargement and consolidation of the structures implicated in the diseased action; nevertheless, the more carefully we examine the cases usually considered as being due to chronic ostitis, originating in the cancellated tissues of bone, the clearer it becomes that instances of this form of disease are rare. It is evident, however, from the case I have just described to you, and from similar instances recorded by Sir B. Brodie, that limited inflammations of bone terminating in abscess do occur. They are generally attributable by the patient to an injury, the symptoms complained of being a deep-seated pain in the bones which is often very severe, and varies in intensity from time to time; the soft tissues covering the bone may appear to be healthy, and there is perhaps little if any perceptible enlargement of the bone. A few of these cases have been cured by cutting through the soft structures and boring through the bone into the abscess. The evacuation of the matter has been attended with the greatest relief to the patient, and in fact cured the disease from which he was suffering; but I need hardly remark that the symptoms must not only have been extremely severe, but the diagnosis, always difficult, must have been very clear, before we should be justified in resorting to so severe a method of treatment.

At the risk of being tedious, I must give you the outlines of another case bearing on this point, and which, like that of H. T., illustrates the effects of chronic inflammation occurring in the osseous tissues, as contrasted with the results of tuberculous disease of the bones, which we shall consider in a subsequent lecture.

J. P., æt. forty. Fifteen years ago, this patient first began to complain of pain in the right knee. There was no history of an injury; he was laid up at this time for two years with intense pain and inflammation near, or in the joint. Subsequently he got somewhat better, and was able to move about again, but still there was frequent recurrence of deep-seated pain in the lower end of the femur.

On admission, the parts covering the knee joint were natural in appearance, but much swollen; there was no excess of fluid in the joint, or indication of its being diseased, but the condyles of the thigh bone were greatly enlarged; there were no sinuses, abscesses, or other indications of necrosed bone in the part. As the patient had suffered for so long and so constantly from pain in the limb, he begged that it might be amputated.

After removal, the joint was found to be tolerably healthy; the ligaments and articular cartilages entering into its composition were normal. The lower end of the femur was greatly enlarged, and in the centre of its cancellated tissue there was a cavity as big as a bantam's egg, surrounded by intensely hard and sclerosed bone. From this cavity, which had doubtless been the site of an abscess (such as we see in H. T.'s os calcis), a narrow passage opened into the knee joint. The outer layers of the shaft of the bone had almost disappeared, and a large quantity of new bone had formed from the periosteum.

In this case, therefore, there is clear evidence that an abscess had formed in the lower end of the femur and opened into the knee joint; the sclerosed bone enclosing the abscess was the result of the inflammation that had occurred in this locality, and this dense hard shell of bone had been a disturbing element in the nutrition of the part for years, leading to the sub-acute inflammation and protracted pain from which the patient had suffered. Had it been practicable in the early stages of the disease to have diagnosed the nature of the morbid process going on in the bone, and to have treated the case upon the principles indicated by Sir B. Brodie, the patient's sufferings might have been prevented, and his limb preserved.

It is hardly possible for me to draw your attention to more instructive specimens of diseased bone than those I now show you, as contrasted with the shaft of this fibula, which I lately excised from the leg of a little boy in Luke ward. In this instance we have an example of acute periostitis in contradistinction to inflammation, commencing in, and being chiefly confined to the contents of the medullary and spongy portion of the bone; and you will observe the difference between the shaft of this tibia, and os calcis affected, the one by acute, and the other by chronic osteo-myelitis, and this fibula in which the periosteum has been destroyed by suppurative inflammation. In the tibia we have seen that the cancellated structure of the bone is mainly affected; but in this fibula it is the external layers of the bone that are implicated, although it is absolutely bare of periosteum from end to end. The superficial layers of the bone are affected in this latter case because they grow from, and receive their vessels through the periosteum; but, as we learn from a longitudinal section through the bone, the medullary canal and the cancellated tissue are healthy.

W. C., aged six, was admitted into hospital on 21st December. He states that his schoolmistress struck him with a cane across the leg. The limb became swollen and very painful. The child's mother has lost the bone of her nose from disease, and the patient is a sickly-looking little fellow. On admission we found the right leg very much inflamed, and of brawny hardness; there were all the indications of a deep-seated abscess in the muscles of the calf of the leg.

On the 23rd a grooved needle was passed into the inflamed limb. No matter appeared, but on a deep incision being made down to the bone, a considerable quantity of pus escaped from the wound. On the 27th another cut was made along the lower part of the fibula so as to give exit to matter. Bare bone was distinctly felt. As the discharge became very profuse, and the child's health was rapidly failing, I cut down on the bone and removed the whole of its shaft, leaving the upper and lower epiphyses and so much of the periosteum of the shaft as had not been destroyed by inflammation.

In this instance inflammation of the periosteum followed an injury, and at first sight the case looked like one of abscess of the calf of the leg, but on passing a grooved needle down into the muscles no pus could be discovered, and we had to cut upon the bone before the matter flowed into the wound. Two free incisions were, therefore, made into the periosteum. The drain of matter was subsequently so profuse that it speedily began to tell on the boy's health, so that I had to remove the shaft of the bone, leaving, however, the upper and lower epiphyses, and I expected that the greater part, if not the whole of the bone would re-form from these epiphyses and the remains of the periosteum of the shaft; and such has been the case. You can now distinctly trace the outlines of a new fibula under the cicatrix in the skin;

in fact, the shaft of the bone has been partly re-formed.

One of the most important lessons we may learn from the case is, that in "deep-seated abscesses," occurring in children or young persons, especially if in the leg or thigh, pass your finger down through the opening you make to allow the pus to escape, and examine the condition of the bone, for in cases of this description you may discover that the inflammation has commenced in the periosteum, and spread outwards into the soft parts.

Acute periostitis seldom occurs except among debilitated children, and the separation of the dead from the living bone is a tedious process attended with profuse discharge, which in time may no less surely destroy the patient than pyæmia would in instances of osteo-myelitis.

We must now return to the case of acute osteo-myelitis I referred to at the commencement of this lecture, and endeavour to master the pathological changes affecting a portion of the osseous tissue when undergoing acute inflammation. We can hardly have a better illustration of what occurs under these circumstances, than that afforded us by sections made through the inflamed spot in the lower surface of the astragalus.

As a consequence of the increased action going on in this inflamed patch of bone, which is in immediate proximity to the cartilage, we find that rapid proliferation has taken place in the nuclei of the neighbouring cartilage cells, each nucleus dividing into four, six, or more segments; but, in addition to this, you may notice that a considerable number of these subdivisions of the nucleus are surrounded by a rather thick layer of granular matter, and this again is enclosed in a case of earthy or inorganic material—I say earthy matter because, in adding acid to the preparation, we see a number of bubbles of gas escaping from this part of the cartilage, and after a time the dark-raised circumference of the cell disappears. I conclude, therefore, that in consequence of the increased action going on in the part, the nucleus of the cartilage cells have grown very rapidly, and a great number of the young cells have secreted a quantity of earthy matter from the blood, forming, as it were, a shell for themselves, and thus building up an irregular lowly-organized bone.

In other parts of this specimen we see that a number of the cartilage cells, or rather their descendants, have united, and bloodvessels having perforated into this conglomeration of nuclei a patch of medullary tissue has been formed in the substance of the cartilage. Some of this cell-growth reaches forward to the free surface of the articular cartilage, forming what is usually described as an ulcer.

In this specimen, therefore, we have clear evidence of the fact that ostitis (or, as I prefer to call it, osteo-myelitis) may lead to the ulceration of the articular cartilages, and that, the cartilage having been perforated in this way, a sinus passes through it, leading very probably into the medullary spaces in the spongy portion of the affected bone.

With reference to the inflamed bone, the most obvious pathological alteration we notice in the specimen now under observation is, that the vessels contained in the medulla are engorged with blood, and that the soft structures surrounding them are stained by the colouring matter of the red corpuscles; it is not simply serum and white globules that have passed from the vessels into the neighbouring tissues, but there has been a disintegration of red corpuscles, and their contents have percolated the inflamed area. Beyond this we observe that the fatty matter contained in the medullary spaces is diminished in quantity, and that the cells of the medulla are greatly increased in number, almost entirely occupying many of the medullary spaces; and doubtless, unless the inflammatory process were excessive in its action, it is from these cells that new bone would have been produced, the layer of newly-formed osseous tissue acting as a protective influence against the absorption of the products of inflammation into the system, in the same way as the walls of an abscess preserve the circulating fluid from the passage of pus into the blood. We have seen remarkable action of the cells in the case of chronic osteo-myelitis, but in the instance now under consideration, the disease being acute, the cells of the medulla have exceedingly multiplied in consequence of the over-action going on in the part, but they have not had fair play; surrounding circumstances have choked their growth, and here we see them crowding and pressing on one another. With a light brush we may sweep away the greater number of the round cells, and then we notice more clearly that the cells of the adenoid tissue in the cancellated structure are infinitely more numerous than in health, and may either degenerate into pus, or become developed into granulation-tissue, according to the intensity of the surrounding action. In addition to these cells the medullary spaces contain a large quantity of free granular organic matter.

I am aware it is a disputed point as to the part which the bone-cells of the lacunæ take in the process of ostitis, but from this specimen you will see that many of the canaliculi leading from the inflamed medullary spaces to the lacunæ are evidently enlarged, most of the lacunæ are three or four times their natural size, and filled with granular matter; in fact, they are in the same condition as the cartilage-cells—a circumstance to be expected, considering they are simply cartilage-cells encased in earthy matter.

The normal function of the living matter contained in the bone-corpuscle is impaired, and you must bear in mind the fact that the osseous structure immediately round one of these corpuscles is, as Dr. Beale says, formed material, being in health repaired and kept in its normal state through the action of the living bone-cell. Destroy this nucleus, or let its functions be perverted by abnormal surrounding conditions, and the nutrition of the area of hard bone depending upon it, being no longer accomplished, a cavity is formed round the bone-corpuscle, which in the case we are now considering is occupied by rapidly growing cells.

Under the influence of the inflammatory process one lacunar corpuscle after another becomes destroyed, the spaces they occupied run into one another, and a cavity occurs in the trabecula, which ultimately opens directly into the nearest medullary space. The form this cavity takes is that of the original growth of the lacunar system, being thus more or less circular in figure.

It is evident, therefore, that the osseous framework of bone plays but a very small part in cases of osteo-myelitis, and, in fact, we may have almost the whole of the soft structures contained in one of the long bones absolutely destroyed and the patient killed from the effects of septic poisoning ; and yet we might examine sections of the dry bone under the microscope, and be unable to discover that the Haversian system had been in any way implicated, illustrating the point I have so often dwelt upon, that the study of pathology is apt to mislead us unless we examine specimens of the structure implicated immediately after death, and alter their condition as little as possible by chemical reagents.

You are aware that authorities believe the disintegration of the bone in cases of this kind is due to the formation, or action of an acid fluid in the inflamed structures, which is supposed to dissolve out the earthy particles from the bone, destroying it by means of chemical action. I can only say that my observations have failed to convince me that any such acid is formed. If such were the case, surely the matter would long ago have been set at rest by chemists.

Nor do we require the help of a theory of this description to explain the phenomena I have noticed, for if the healthy functions of the nucleus or living portion of the cell is destroyed, evidently the parts around which depend upon it being no longer repaired, a cavity must result in the osseous structure, such as I have described. In ordinary language, if the source from which a stream has been fed becomes dried up, we hardly talk about the river having become absorbed; and so in the matter of the cartilage and bone-cells, if the living material from which the parts are produced ceases to be, evidently an empty space occurs around the site of the original cells, which cavity, as in the instance now under consideration, may speedily be filled up by extraneous matter.

As the inflammatory process advances in the medullary cavities of bone, pus and the disintegrated surrounding materials become mixed together in a decomposing mass. Septic matter of this kind, although no external air is admitted into it, sometimes acts as a deadly poison if introduced into the circulation. I have seen death resulting from a large plug formed in the right side of the heart, and extending into the pulmonary artery, from the absorption of matter of this description, from an injured spot in the diploe of the skull, and in another instance from disease of the head of the femur. The tendency to septic pyæmia is enhanced when air gains access to the products of the inflamed bone, as is usually the case in acute osteo-myelitis, there is then no chance of a limiting membrane being formed round the inflamed part, for the bone-producing cells are unable to fulfil their purpose, and hence the blood-poisoning that so frequently occurs in this form of disease.

In acute periostitis the condition of the inflamed structures differs from that found in osteo-myelitis, as the section of this fibula demonstrates: in this instance although suppuration has occurred in the periosteum and the outer layers (but not the medullary canal or cancellated tissue) of the fibula have been laid bare, still the soft structures outside the periosteum have also been inflamed ; in fact, an abscess has formed round the bone, and the inflamed area is thus to some extent limited by consolidated tissues, through which the absorption of the products of the inflamed structures into the system is hindered. It is true so grave a lesion to the periosteum as that above alluded to must affect the nutrition of the bone, but, unless the contents of the medullary canal or cancellated tissue participate in the inflammatory action, the patient's life is not likely to be endangered from pyæmia.

In the case before us the contents of the medullary canal and Haversian surrounding system seem to be healthy, their vascular supply being derived from the nutrient artery of the bone; but in the outer layers of the fibula, which have grown from, and been nourished by, vessels from the periosteum, we find that a number of cavities have been formed through the breaking down of lacunæ in the manner I have described, and layers of bone surrounding the shaft of the fibula were becoming necrosed in this way.

It is easy, however, to imagine that in acute periostitis the inflammatory action might be propagated along the connective tissue surrounding the vessels passing into the cancellated tissue, and set up a similar action in the medullary structure, but then the disease is no longer one of periostitis, but of osteo-myelitis.

From a practical point of view we may conclude that in acute periostitis, although the fever runs high and the parts affected are intensely inflamed, still we may fairly hope, by free incisions down to the bone, to arrest the danger of septic poisoning; and if the disease has occurred to parts below the knee- or elbow-joint, we may save the limb. The case is much more serious if the humerus or femur is attacked by acute and rapidly spreading periostitis; not only is disease between the diaphysis and epiphysis apt to occur, but the surrounding tissues become extensively implicated, vessels may be eaten into, and the loss of blood and profuse drain of matter from the part renders amputation at the shoulder- or hip-joint necessary, and I need hardly add that these are operations from which we justly shrink. If, on the other hand, during an attack of this kind, pyæmia supervenes, it is probable that the medullary tissues are implicated; and then, in my opinion, the sooner the part is removed at the joint beyond the disease the greater will be the chances of the patient's recovery; every day, I may say, almost every hour, you delay this proceeding renders the prognosis more unfavourable.

EPIPHYSITIS.

Inflammation commencing at the line of junction between the diaphysis and the epiphysis of various bones, is, I believe, a more frequent form of disease than is generally supposed; thus, we have had several unquestionable cases of the kind in the wards within a short period of time, and I have certainly met with no inconsiderable number of such cases during the past twenty years. I may at once remark that the affection I am considering is almost identical in its nature with that of acute osteo-myelitis, extending to the periosteum. In fact, inflammation arising at the line of junction between the diaphysis and the epiphysis, through continuity of structure, necessarily involves the periosteum surrounding the extremity of the bone.

Epiphysitis is most commonly met with among infants or at any rate in children of not more than three years of age; nevertheless, from the second case I shall bring to your notice, it is obvious that the disease may occur at any time prior to the epiphysis becoming united to the shaft of the bone. This disease generally runs an acute and too often a fatal course, for the pus and other putrefying matters formed from the diseased structures are sucked up into the vascular spaces in the cancellated end of the bone, and fatal septicæmia is the result; especially as, the course of the disease being acute, the matter forces its way through the skin, and air is admitted into the disintegrated tissues, and so the work of septic poisoning is speedily accomplished.

Inflammation commencing in the epiphysis is not unfrequently mistaken for disease of the neighbouring joints—in truth, a mistake of the kind occurred in the first case I have to relate to you—and I do not know that it would be possible to diagnose the nature of the affection after it has existed for a few days, except by means of the finger or probe passed down to the diseased bone.

S. S., æt. three weeks, was admitted into Queen Anne's ward, on the 10th June. The child's mother was a strong, healthy woman, and had two other children, both living. Our patient, who had been exclusively fed on the mother's breast, appeared to be a well-nourished infant, with no marks of syphilis or any other specific disease about her. We failed to elicit any history of syphilitic disease in the case of either of her parents. Five days before bringing the child to the hospital, Mrs. S. observed that her infant's left knee had become very much inflamed. She could assign no possible cause for this state of things. The swelling of the limb increased rapidly, and within four days matter formed and burst externally at the inner and lower end of the thigh.

On admission, the left knee, and the parts above and below it were intensely inflamed, pus was discharging from the wound close to the knee, and a probe inserted through this opening could be passed into a cavity extending across the lower part of the femur, in which bare bone was felt; and, as I have before remarked, the case was supposed to be one of "acute arthritis of the left knee-joint," and entered as such on the patient's admission ticket. A counter opening was made along the outer side of the limb so that free drainage was established. Cold applications were employed, and the limb kept at rest on a splint. On the following day I found the little patient evidently sinking rapidly, and she died within thirty-six hours of my visit to the hospital.

I may here remark that over the olecranon process of the left arm I found a small abscess, but with this exception there was no evidence of suppuration in connection with any other epiphysis of the body. On a post-mortem examination the skin over the left olecranon process was found of deep crimson colour, and underneath it was a collection of reddish-brown fluid. At the junction of the epiphysis of the olecranon with the ulnar the bone was deeply congested and unquestionably in a state of inflammation. But the disease was confined to the line of ossification, the periosteum was not involved, and the soft parts to a limited extent only, as we saw during life. The same remark applies to the condition of the left tibia at its junction with its upper epiphysis—the periosteum of the shaft of the bone was congested, but suppuration had only occurred at the line between the diaphysis and the epiphysis.

There was no disease whatever of the left knee-joint; the ligaments and other structures entering into the formation of this articulation were healthy.

The lower epiphysis of the femur was separated from the shaft of the bone by a cavity filled with pus. The outer surface of the lower extremity of bone was denuded of periosteum; the medullary structure of the diaphysis was intensely inflamed, the lower end of the bone, in fact, affording us a well-marked illustration of the effects produced on the osseous structures by acute osteo-myelitis. I think if we consider the circumstances of the tissues I have described as a whole, we can hardly doubt that from some unknown cause suppurative inflammation had in the case of this patient been established in the medullary structures at the line of ossification between the diaphysis and epiphysis of the various bones I have enumerated, and that the intensely-inflamed condition of the lower part of this infant's thigh had commenced in the disease between the diaphysis and epiphysis of the lower end of the femur.

The condition of the limb and the fact stated by our house-surgeon, that a probe inserted through the opening in the skin in its course touched bare bone both above and below the instrument, enabled me, when first I saw the child, to point out to the class the nature of the disease, and to explain the reason of the dangerous condition which the patient was in, being as she then was well nigh in a state of collapse from the effects of septicæmia. Evidently if the disease had commenced in the knee and run on to suppuration a probe passed through the joint would not have impinged throughout its course on bare bone, the articulation being constituted of the soft cartilaginous epiphysis of the femur and tibia in the case of so young an infant as this; but as I before remarked, unless by examination with the probe, or still better the finger, I think I should have been at fault as to the diagnosis of the disease in this case; it precisely resembled an instance of suppurative inflammation of the knee-joint.

In a subsequent lecture we shall consider a peculiar abnormal condition of the bones of infants at the junction of the epiphysis and diaphysis, the result of inherited syphilis, but the affection I have just described differs from that found in instances of syphilitic children. There was nothing in the history or symptoms of the above case to lead us to suppose that the patient was under the influence of inherited syphilis; there was no enlargement of the bones at the seat of disease so characteristic of syphilitic affections, and, had it arisen from specific hereditary disease, the course of the malady would not have been so acute.

It is important you should have clear ideas on this matter, because you will certainly meet with cases of epiphysitis, and if you form a correct diagnosis from the first, and make a free opening down to the epiphysis, and establish effectual drainage to relieve the tension of the surrounding structures, allowing the products of the inflamed tissue to escape, you may fairly calculate, not only on saving your patient's life but on preserving the limb and a useful joint.

I make this statement with confidence, because I have lately had the infant child of an Indian officer under my charge suffering from epiphysitis of the lower end of the right humerus, in which a most satisfactory result has been attained by means of treatment such as that above indicated.

But acute inflammation commencing at the time of ossification is, as I have before remarked, not confined to the cases of infants, as the following instance proves:—

W. Y., æt. fourteen, was admitted into the Henry Hoare ward, having been sent up to the hospital from Oxfordshire suffering from "acute inflammation of the shoulder joint." In this case the lad's parents were healthy country people; his brothers and sisters, five in number, "were never ailing." Fourteen days before W. Y. came under my care, his left shoulder became excessively painful and inflamed, matter formed, and an abscess opened half way down the arm. Under these circumstances he was sent to the hospital. On admission we found the soft parts covering the patient's shoulder and upper parts of his arm were greatly inflamed, and a profuse discharge of pus poured away through various openings in the skin. The poor boy on admission was jaundiced, he had a dry tongue, was delirious at night, having a very high temperature, profuse perspirations and diarrhœa—in fact he was in the last stage of pyæmia.

On passing a finger up through the sinuses towards the head of the humerus I found the epiphysis was separated from the diaphysis, and that the bone was bare of periosteum for an inch or so below its upper extremity.

As you see from this specimen, the upper epiphysis in this instance is distinctly detached from the diaphysis, the medullary structure of the latter being in a state of suppuration, but the cartilages of the glenoid cavity and head of the humerus are healthy.

The disease no doubt in this case commenced between the diaphysis and epiphysis, and extended for some distance along the periosteum; and had the patient lived we should subsequently have found the shaft of the bone bare and necrosed, as in the instance of W. C. that I described to you as a case of acute periostitis of the fibula,

(p. 35); I suspect that not a few of the instances of so-called suppurative periostitis commence in inflammation of the structures at the line of ossification between the diaphysis and the epiphysis, and this may be the reason why we only meet with instances of "acute periostitis" among children and young persons.

LECTURE III.

HYPERTROPHY—HYPEROSTOSIS—CHRONIC RHEUMATIC ARTHRITIS—DIFFUSE SCLEROSIS OF BONE.

Hypertrophy of bone. It is well in discussing affections of bone, as in other matters, to try to call things by their correct names, and so to consider hypertrophy as being an increased development of the characteristic elements entering into the formation of the osseous tissue. If these elements are altered in their relations to one another the case is no longer one of simple hypertrophy, but hyperostosis, or enlargement of the bone from some abnormal condition. For instance, I may refer you to this specimen of the lower end of the femur taken from the knee of a girl who had suffered some years before from disease of the joint, caused in all probability by an abscess which had formed in the popliteal space, and burrowed into the joint leading to the destruction of the articular cartilages and ligaments. The upper end of the tibia was drawn backwards by the ham-string muscles, and the lower articular surface of the femur having been relieved from the pressure which in health would have been continually exercised on it by the tibia, has become hypertrophied. The osseous structure in the excised portion of the bone is normal in character, but there is more of it than existed in the corresponding part of the other limb. From a practical point of view this specimen teaches us an important lesson, which is, that under circumstances such as those above mentioned the end of the femur may become enlarged, and we can therefore readily comprehend the reason why we sometimes experience difficulty in rectifying the malposition of the limb produced by old-standing disease of the knee joint. We may divide the tendons of the ham-string muscles, bands of contracted fascia, and break down the anchylosis which often exists in cases of the kind, and thus for a time bring the ends of the tibia and femur into apposition, but our efforts fail in keeping them there, and the leg gradually reverts to its flexed position on the thigh, the truth being the condyles of the femur have become hypertrophied anteriorly, and until we remove them the tibia necessarily slips behind the enlarged portion of the bone.

Before proceeding, however, to excise the joint or hypertrophied end of the femur in cases of this kind, we are most certainly bound to divide the tendons and break down existing anchylosis, so as to endeavour to straighten the limb. It is only after the failure of this plan of treatment that we have a right to excise the ends of the bone, or, what in some cases will answer as well, to remove a wedge-shaped piece from the femur, so as to straighten the limb.

As a case in point, I may refer you to the history of E.B., æt. eighteen. From notes kept by Mr. Butler, it appears that when two and a half years of age the patient fell and injured her left knee. She was subsequently under treatment for a lengthened period in several of the London hospitals and ultimately was admitted into Westminster for the purpose of undergoing the operation of excision of the left knee joint, or of some modification of this proceeding, by means of which her leg might be rendered useful, as she was unable to put her foot to the ground.

When I first saw E. B., her left leg was fixed at an obtuse angle on the thigh, the patella and joint were immovable, and the anterior part of the condyles of the femur were enlarged. I had the patient brought into the theatre, and, with Mr. Pearce Gould's assistance, the contracted tendons and fascia in the popliteal space were divided, and the adhesion having been broken through the leg was brought into a straight line with the thigh, and secured there by means of splints and bandages.

The result has been very satisfactory. There has been no tendency for the leg to be drawn backwards, and if the condyles of the femur were enlarged, they have not prevented the adaptation of the head of the tibia to the end of the femur, so that the patient can use the leg and walk about with perfect ease.

One of the principal objections to dividing contracted tendons and fascia in the popliteal space is the danger of cutting through the external popliteal nerve, and so paralyzing some of the muscles of the leg. To avoid this accident, which has happened in several of my own cases, I now make a point of dissecting out the tendons and structures to be incised. If this operation is performed antiseptically it excites no more irritation than if the tendons were cut subcutaneously.

But to return to our subject. I have here the skull of an adult patient, who in childhood suffered from rickets. The inner and outer tables of this cranium are somewhat thickened but not unduly so in proportion to the space occupied by the diploe, which is evidently far greater than it would have been in a healthy bone. The skull is very much thicker than it ought to be, but its characteristic elements bear their normal relation to one another; in other words, the bone is hypertrophied.

In this instance, during early life the bone-producing cells were insufficiently supplied with the elements necessary for the construction of healthy osseous tissue; the medulla therefore grew apace, unrestrained by the pressure of any bone shell around it. After a certain period, however, a more healthy process of nutrition was established in the part, and the superabundant medulla set to work and manufactured this thick skull, which was built up in accordance with the laws governing the development of healthy bone. It was simply the excess of the bone-producing material which caused the existing hypertrophy. In many cases of the kind, as I shall explain more fully in my lecture on rickets, the osseous structures under these circumstances become sclerosed rather than hypertrophied.

In the instances above referred to the abnormal growth of the bone has been due to a deficiency in the controlling, or compensating pressure which the structures of the body exercise upon one another, in order to keep the nutritive functions properly balanced, and the machine in perfect working order.

Another example of this principle, as Professor E. Wagner remarks, is "seen in the ordinary form of genu-vulgum, *e.g.*, of bakers, which occurs through excessive growth of the internal condyle of the femur; this arises from want of resistance exercised from the corresponding portion of the tibia during standing for hours at a time with bent knees." In the same way we explain the excessive growth of a tooth in one jaw when the corresponding one in the other jaw is absent.

Hypertrophy of bone is supposed to occur in persons who go bareheaded, from exposure, causing hyperæmia of the scalp, but this is pure fiction as I can affirm from my own observations, and it would appear reasonable if bones were liable to be affected from this cause that those of the face would suffer more than the skull, because they are more constantly exposed.

Again, hypertrophy of bone is said to have been met with in cases where a sort of monstrous growth occurs without any obvious cause, inequalities of the sides of the body, of the hands or fingers being the result; but I strongly suspect that in instances of this kind the characteristic elements of the osseous tissue have been considerably modified, the case being one of disease and not of hypertrophy, which, excluding instances such as those to which I have referred, is a rare deformity of bone.

Hyperostosis, or enlargement of the bones, may be either general or partial; this condition differs from that of hypertrophy in that the overgrowth of the bone is due to disease, and so the characteristic elements entering into its formation deviate more or less completely from that of healthy osseous tissue. In a case of general hyperostosis in which the patient, a man sixty years old, had been affected for twelve years with enlargement of all the bones of his body, and ultimately died from asphyxia through disease of the ribs, Dr. Goodhart found the surface of the bones porous, with a singular mortar-like appearance; the periosteum was normal, but the bone was pink throughout, and firm and heavy, much softer than healthy bone. The bones were all enlarged, the left clavicle for instance being two and a half inches in circumference, with hardly any medullary cavity, and no cancellous tissue. The femur weighed 2 lbs. 14 oz., and was from 6 to 8 inches in circumference. The microscope showed that the diseased bone had undergone considerable change. The Haversian canals were enlarged and irregular in shape.

This case presents features in common with a remarkable instance of general hyperostosis lately brought to the notice of the Medico-Chirurgical Society, by Sir J. Paget. In this instance one of the patient's sisters "died with chronic cancer of the breast." The patient remained in good health until he was forty-six years of age, he then began to be subject to aching pains in his thighs and legs; his shins became mis-shapen, broad, nodular, and uneven, as if not only the bones but the periosteum and integuments over it were thickened. In the course of time the tibiæ became curved anteriorly. Subsequently the femurs, pelvis, and ultimately his skull became much enlarged: for instance, his head in 1844 measured 22½ inches, in 1876 27¼ inches; in its enlargement, however, the head retained its natural shape. The spine became slowly curved and rigid, the chest contracted and narrow. He died at the age of sixty-eight. Nearly all the bones of his body had been more or less affected. The disease had existed for some twenty-two years, when the patient died from pleural effusion. After death numerous small nodular masses of pale cancerous substance were found scattered in the lungs, others were seen growing from the affected bones. As a general rule the outer surface of the bones was nodular, the compact substance in every part was increased in thickness, and Mr. Butlin reports that the Haversian canals were diminished in number, and enormously widened, many of them were confluent, and filled with an homogenous or granular basis, containing cells of round or oval form about the size and having the appearance of leucocytes. Large nucleated cells were also present, and fibres, or fibro-cells, sometimes in considerable quantities.

A third case of the kind was lately brought to the notice of the Pathological Society by Dr. Cayley. The patient was a man sixty-five years of age, in whose family history there was nothing pointing to cancer. When he came under Dr. Cayley's care he was much emaciated, and his skin was studded with the small nævi, described by Mr. de Morgan in association with cancer. The tibiæ were curved and enlarged, but not painful nor tender; and there was general uniform enlargement of the lower jaw, and protuberance of the right parietal bone. The patient dying from dyspnœa, the right lung was found to be shrunken and carnified, the pleural cavity obliterated, cancerous masses occurring in the lung and pleura. The liver also contained some cancer nodules, but in no other part was cancer found. The gastric mucous membrane was atrophied. Each tibia was greatly increased in circumference, the increase being in great part due to overgrowth of compact tissue, although the medullary cavity was large, and filled by pale, gelatinous marrow. The compact tissue was light and porous. The fibula was not enlarged, and hence the excurvation of the tibia. The lower jaw was uniformly enlarged, both as to its rami and body, and it was almost edentulous. One of the bicuspid teeth, lodged in a carious cavity, presented curious nodulation of its crusta petrosa. The bones of the calvaria, especially the right parietal, were increased in thickness and very porous in texture. The left clavicle had undergone a similar change.

On a future occasion, when speaking of osteo-malacia I shall endeavour to explain to you the nature of the morbid changes which lead in the adult subject to softening of the osseous tissue. In instances of general hyperostosis, such as those now referred to, possibly, at a certain stage of the disease, the affected bones undergo a process of softening which, if it were continued, would lead to incurable osteo-malacia. But, in the instance of hyperostosis under consideration, the morbid action going on in the medulla, which brought about the softening of the bone, has not entirely destroyed the bone-forming cells, and so new bone has been produced in larger quantities than in health ; because, during the process of softening, the medulla has been partially unrestrained in its growth by the diminished resistance of the surrounding calcified osseous structure, and thus when the medulla occupying this soft bone was enabled to perform its normal functions, it built up a large quantity of new porous bone such as we see in this specimen. It seems to me that we can only account for the deformed condition of these tibiæ by assuming that at some stage of their life they have been soft and pliable, yielding as in rickets to muscular force or to the weight of the body; but the gradually increasing size of the bones points to the fact that one part of the osseous tissue after the other became implicated, as also did one bone after another of the skeleton become involved in the diseased process.

The deep-seated pain in the limbs, tottering gait, and other symptoms so faithfully described by Sir J. Paget as existing in his case of general hyperostosis, remind us very forcibly of the characteristic symptoms of osteo-malacia, so much so, that we are hardly surprised to find the condition of the medulla recorded by Mr. Butlin, as existing in the case above referred to, corresponding with the microscopical appearances presented by sections which I have made through the bones of a patient who died from osteo-malacia, the result of sarcoma. The idea that there is some connection between the condition we call general hyperostosis and osteo-malacia is confirmed by the further clinical histories of these diseases. For instance we had lately a case in the hospital of a woman, Mrs. L., æt. fifty-six (Chadwick ward), suffering from a large osteo-sarcomatous tumour of twelve years' standing, growing from the upper end of the right humerus. Within the last two years she has complained of deep-seated pain in her lower extremities, both tibiæ are enlarged, and the right shin bone, as my patient remarked, "was becoming much bowed." So that the lengthened course of the disease in Sir J. Paget's case, does not appear to militate against its having been sarcomatous, perhaps of the same description as that which killed his patient's sister, for she died of "chronic cancer of the breast."

It seems to me, therefore, that many of the specimens of hyperostosis which we meet with in our museums are instances of sarcomatous affections of the medulla, single bones only having been preserved; or it may be, the patients have died from some other cause before many of the bones were implicated in the diseased action. But although I think that general hyperostosis is commonly due to sarcoma, and that its various forms, designated as either porous or hard hyperostosis, are simply modifications of the same morbid action; it is quite certain that local enlargement of the bones may occur under very different circumstances—for instance, in syphilis the osseous forming-cells of the periosteum are more frequently involved than that of the medulla, and so give rise to local and sometimes extensive hyperostosis of the bones. In cases of this kind the history of the disease will guide us to a correct diagnosis regarding the malady.

But there are other cases of hyperostosis in which it seems probable the abnormal growth from the periosteum may be induced through perverted nerve-action, influencing the nutritive changes going on in the part. There are several remarkable specimens of periosteal hyperostosis preserved in our London museums, one side of the skull and bones of the face being enormously enlarged over an area supplied by various branches of the fifth nerve; but as we should have expected from the anatomy of the osseous tissue, the abnormal growth, in instances of the kind, is confined to the periosteum, for the medulla being sparingly supplied with nerves is hardly involved, unless through the mechanical interference with its nutrition produced by the changes occurring in the periosteum.

I would therefore assign, as the cause of general or widely disseminated hyperostosis, a sarcomatous diathesis.

Local hyperostosis, in contradistinction to tumours of bone, is, as a rule, due to syphilis, chronic rheumatic arthritis, to injuries, such as I am about to describe to you, or it may be in some exceptional instances to lesions of nerves altering the nutrition of a limited area of the periosteum. It is difficult, I think, to assign inflammation as the sole cause of either local or general hyperostosis; for sclerosis, necrosis, and molecular disintegration of the affected bones are the sequence of inflammatory diseases of the osseous tissues.

CHRONIC RHEUMATIC ARTHRITIS.

Arthritis deformans was, by the first English surgeon who describes the disease, designated "Nodosity of the joints." This affection may be conveniently considered in connection with the subject we are now discussing, for the outcome of the morbid action is an extensive hyperostosis of the bones entering into the construction of the various joints of the body.

It will save time and perhaps assist us in forming something like a definite idea regarding the circumstances of this disease if I refer to one or two points connected with the etiology of chronic rheumatic arthritis.

In the first place, the inhabitants of certain countries hardly ever suffer from articular rheumatism or gout, and among these people chronic rheumatic arthritis is unknown. On the other hand, wherever rheumatism and gout prevail, there persons among all classes of society suffer from arthritis. This fact if taken alone would afford us but inconclusive evidence regarding the connection between rheumatic gout and chronic rheumatic arthritis, but when we find that the latter affection almost always begins in an attack of articular rheumatic gout, we can hardly fail to believe that chronic rheumatic arthritis is, as Dr. Adams of Dublin so ably argues in his work on the subject, a gouty or rheumatic affection. Our interest in the question is great, because the notions we form regarding the proper treatment of the disease must depend to some extent upon the views we entertain as to its cause.

I admit that the absence of chalky deposits around the joints of persons affected with chronic rheumatic arthritis is a remarkable circumstance, if the disease depends on a gouty diathesis. At the same time it may be fairly argued that the malady in question is the outcome of a different form of the same action, which under other circumstances would have produced the chalk stones of gouty persons; or, in other words, if these formations had occurred, the patient would not have suffered from chronic rheumatic arthritis.

Another reason urged against the intimate connection which we believe exists between rheumatism, gout, and the disease we are discussing, is, that the latter not uncommonly originates in an injury to the affected part; but this reasoning is hardly sound because we frequently meet with cases of gout following a sprain or contusion of the various joints of the body; and, moreover, as I shall presently demonstrate, the condition of the bones supervening on some forms of injury are closely analogous to those found in cases of chronic rheumatic arthritis.

We frequently find in this disease that almost all the joints of the body become affected, but although this is the case, the abnormal action may be confined to the hip, the shoulder, or any other joints; but we may lay it down as a rule that chronic rheumatic arthritis only manifests its presence characteristically in the articular cartilages and the cancellated tissue of the bones in the proximity of the articulations. The shafts of the affected bone may become sclerosed, but this alteration is by no means a peculiar feature of the disease we are considering.

In illustration of the course which this affection follows and of the pathological changes observed after death, I may refer to instances of chronic rheumatic arthritis of the knee-joint, because I have an injected specimen of the knee, taken from the body of an old man who was run over and killed. Finding his right knee was extensively diseased, I injected the femoral artery immediately after death, and subsequently excised the knee joint and a part of the bones of his foot.[1]

The commencement of this disease in the knee (or any other joint) is marked by slight pain, not sufficiently severe to prevent the patient from walking about. Year by year the stiffness and pain in the knee increase, the part becomes swollen, ultimately the ham-string muscles may become contracted so that the leg is slightly bent backwards and inwards and the foot somewhat everted.

In its early stages effusion of fluid into the joint exists, and gradually augments in quantity, so that after a time the knee may become very much

[1] In this account of the symptoms presented by a case of chronic rheumatic arthritis I have closely followed the admirable description of the disease given by Dr. R. Adams ("A Treatise on Rheumatic Gout," by Dr. R. Adams, M.D. Second edition. Page 190).

increased in size. The bursæ in connection with the joint, as well as those around it, are frequently distended with fluid, and so the knee often presents a nodulated, swollen condition, the skin covering the part retaining its normal appearance. If the joint is alternately flexed and extended, articular crepitation becomes manifest. In the later stages of the disease the synovial fluid is often absorbed, but the grating produced by rubbing the surfaces of the bones against one another becomes more evident; it is perceived by the patient himself in all movements of the joint, and can even be heard by the bystanders.

Subsequently the patella and the articular ends of the femur and tibia become enlarged, and nodules of ossific matter can be distinguished round the extremities of the bones.

Foreign bodies may almost always be felt in the affected joint; they are sometimes as large as a filbert, and can generally be moved from one part of the synovial sac to another; and should they lodge between the ends of the bones during the time a patient is walking, they cause him considerable and sudden pain, often followed by an exacerbation of his symptoms.

Although the patient may in the course of time become bedridden if both knees are affected, still there is seldom any acute suffering in this form of disease—no starting of the limb at night, no increase of pain on stretching or pressing the tibia against the condyles of the femur; suppuration of the joint does not occur, but we have chronic synovitis, enlargement of the articular ends of the bones, crackling in the joint, and the presence of foreign bodies in it, together with the deformity, and, lastly, very probably an immoveable condition of articulations which have for years been affected by this distressing disease.

On examining the ends of the bones implicated in the course of chronic rheumatic arthritis, we find, as in this specimen, that the synovial membrane is deeply congested and thickened, and projecting from its surface are a number of fibrous excrescences which hang into the interior of the joint.

The semi-lunar cartilages have entirely disappeared, together with the greater part of the articular cartilages.

The ends of the bones and the patella entering into the composition of the joint are greatly enlarged. You notice how broad and excavated the articular surface of the tibia has become. Its cartilage and the calcareous lamina of bone beneath it have entirely disappeared—in fact it presents an appearance exactly like that of this tibia, taken from the leg of a patient whose knee-joint had been excised some years previously. The condyles of the femur have excrescences projecting from their lateral and posterior surfaces, similar to those seen round the head of this tibia. Dr. R. Adams remarks: "The vegetations or nodules of semi-transparent bone cartilage are characteristic marks of this chronic disease, whether we examine it in its effects on the head of the humerus or femur, or here, on the lateral as well as posterior margin of the condyles." I cannot agree with Dr. Adams in this opinion, because you see in the specimen of this excised knee-joint that there are precisely similar outgrowths of bone from the ends of the femur as those described by Dr. Adams in chronic rheumatic arthritis.

In studying the pathology of this affection we must remember that in all cases the early symptoms of the disease are characterized by a synovitis, to be numbered not by weeks or months but by years; and what does this mean, but that during the greater part of that time the structures entering into the formation of the affected joint are in an abnormal condition, one of the results being a diminution in the vitality inherent in the cells upon which the normal condition of the semi-lunar and articular cartilage depend? In the early stage of the disease the free surfaces of these cartilages are yellowish, rough, and undergoing fibroid degeneration. The subcartilagenous osseous lamina, depending as it does for its growth and maintenance on the cartilage cells, also degenerates, and is frequently absent in cases of chronic rheumatic arthritis, so that the porous cancellated tissues of the bone, with its medullary contents, are laid bare, and in an injected specimen such as this, we see the medulla projecting from the open end of the bone as a granulating or fungating mass. Some of this medulla has undergone ossification, and the newly-forming osseous tissue being crowded with bone-cells, has passed into a state of sclerosis—petrified, if you like that word better, and this dense ivory-like bone projects in ridges and smooth nodules from the articular extremity of the femur into the joint.

In this particular specimen the degeneration in the cartilages probably commenced in those covering the head of the tibia, and as the condyles of the femur came to press upon the open soft cancellated tissue of the head of the bone—the patient still moving about—the end of the tibia was squashed outwards, and some of its medulla forced over the outer margin of the bone, where, in conjunction with the cells of the periosteum it has ossified and formed this crown of new bone round the joint. You will observe a precisely analogous pathological condition existing in this femur, amputation having been performed some years after excision of the knee-joint. The lower end of the bone is surrounded by an osseous growth, because the condyles having been excised, the pressure of the tibia against the open soft cancellated tissue of the femur had, as I have before remarked, squeezed and flattened the end of the bone, forcing outwards some of its medulla, which, with the periosteum, has produced these fringes of new bone round the end of the femur, formed from the contents of the bone, like icicles from a vessel of overflowing water. In another specimen I have here you see the same result has occurred to the tibia after the excision of the knee-joint.

I revert again to our specimen of chronic rheumatic arthritis. We find that a portion of the condyles of the femur are sclerosed: in this and in most examples of the kind taken from the knee and elbow joints, the ridges of sclerosed bone correspond to depressions in the opposite bone. In the head of the femur and humerus, the pressure being equal in all directions, the articular surfaces of the diseased bone are generally round and smooth.

It is impossible to suppose that a long continued synovitis with the great amount of distention of the synovial sac, so often seen in these cases, can exist for years without interfering with the circulation through the vessels passing from the soft parts into the cancellated ends of the bone; the hyperæmia, or disturbance in the blood supply of the medulla, thus produced leads to the deposit of an excessive quantity of bone earth in the organic matrix and canaliculi of the bone, and so to sclerosis. This is especially conspicuous in these ridges of bone corresponding to depressions in the opposite bone, which are less subject to pressure and friction than other portions of the articular surface. These ridges have therefore partially retained their cartilages beneath which the formation of new and ultimately sclerosed bone may be seen to be in progress, the bone earth commencing to be deposited in the hyaline structure round the deeper layers of the cartilage cells. In fact, some of these specimens of chronic rheumatic arthritis afford us an excellent illustration of the transformation of cartilage into bone cells.

With reference to the treatment of this affection it is evidently useless hoping to cure the disease if of long standing, the bones having become affected in the manner I have described. On the other hand, if treatment is resorted to in its early stages, and the patient is in a position to resort to some of the bathing establishments of Europe, much may be done to relieve his symptoms. Of these baths I think those of Mont Dore, in central France, and Aix les Bains, are the most serviceable in the class of cases we are considering; not only is the system of douches and hot baths employed in these establishments beneficial, but the climate adds unquestionably to the efficacy of the treatment. To those persons who cannot go abroad, the baths at Buxton and Droitwich may be recommended. I would, however, insist on the fact, that treatment of this sort, to be useful, must be resorted to in an early stage of the disease. It is too often postponed until all other remedies have failed, that is, until irreparable damage has been done to the articular cartilage and the ends of the bone, when, in fact, the time has passed for anything more than the palliative treatment of the disease.

There is, of course, a large number of patients suffering from chronic rheumatic arthritis who are unable to resort to bathing establishments: under these circumstances, and even in the advanced stages of the disease, relief may be obtained by well applied friction to the affected joints, the compound iodine liniment being rubbed into the part, and the joint carefully shampooed for a quarter of an hour night and morning, and subsequently protected with a flannel bandage.

Damp localities must, if possible, be avoided as places of residence, and the patient's diet regulated according to his condition in life, and the ideas you have formed as to the correct regimen in cases of rheumatic gout.

The enlarged bursæ round the joints, so constantly met with in cases of this disease may be emptied of their contents by means of the aspirator, and then a solution of one part of iodine to six of glycerine injected into the sac of the bursa. I need hardly remark that we must proceed with caution in cases of this description. Some patients seem to be intolerant of any such treatment, and inflammation is readily excited in the bursa and neighbouring synovial membranes.

DIFFUSE SCLEROSIS OF BONE.

I now pass on to consider another affection of the bones, which is somewhat allied to those I have brought to your notice in this lecture. By the term sclerosis of bone we mean that the part affected has become abnormally dense in consequence of changes that have occurred in its physical structure.

Under certain circumstances we know that living bones become exceedingly hard, so that on attempting to cut them with a saw or chisel, we have to work through structures which remind us more of ivory than anything else; and if you make sections of a bone affected in this way, and grind it down for microscopical purposes, you will find that it requires patience to accomplish your end. The chances are that, just as you have made a sufficiently thin preparation for examination by means of transmitted light, and you are giving it the last touch, it breaks into several pieces; and so you learn by experience that whatever the changes which have taken place in the bone, it has become harder and more brittle than healthy bone should be. I wish, however, on this occasion, to draw your attention to an affection in which the entire or greater part of one of the long bones becomes heavier and denser than natural. This condition of bone is described by Billroth as *diffuse hypertrophy*, or *condensing ostitis.*

We have lately been engaged in considering some of the diseases depending upon abnormal conditions of the medullary or soft structure contained in bone, but we must not overlook the fact that there is a large quantity of organic matter entering into the composition of the osseous tissue beyond that which is enclosed within its medullary and cancellated spaces; for, as you well know, the form and size of a bone is retained after its inorganic matter has been removed by means of dilute hydrochloric acid. The hyaline matrix of the bone which remains is formed from the cells contained in embryonic cartilage. The nuclei of the cells during the process of ossification secrete bone-earth from the serum of the blood, becoming encased in a shell of earthy matter.

The canaliculi are the minute channels of communication between contiguous lacunæ (bone cells), which they also connect with the Haversian system and the open spaces in the cancellated tissue of the bone. In a specimen of healthy bone, the lacunæ and canaliculi occupy hardly less space than the material in which they are situated, so that, if from any cause the bone cells and the canaliculi become filled with organic and earthy matter, the portion of bone affected in this way must be harder and denser than the original bone in proportion to the amount of materials which have been deposited in the part; at the same time any given weight of bone which has undergone changes of this kind may contain its normal proportion of inorganic and organic elements; its density is increased, but not the relative quantities of its chemical constituents.

Dr. Stark demonstrated the fact many years ago, that "the hardness of bone does not depend upon the amount of earthy matter it contains; the difference in hardness and sponginess depends on its physical structure." This is precisely the conclusion we have arrived at from an examination of specimens of sclerosed bone we have here. Thanks to Dr. Dupré, we have evidence regarding the relative proportions of the elements contained in these bones. Our Professor of chemistry informs us that they are composed of—

Inorganic matter insoluble in water ...	50·13
Inorganic matter soluble in water ...	·96
Fat	5·50
Other organic matter	32·97
Water	10·44
	100

Consequently, although these specimens of bone are sclerosed, and therefore excessively dense, they nevertheless yield, in a given weight, elements in

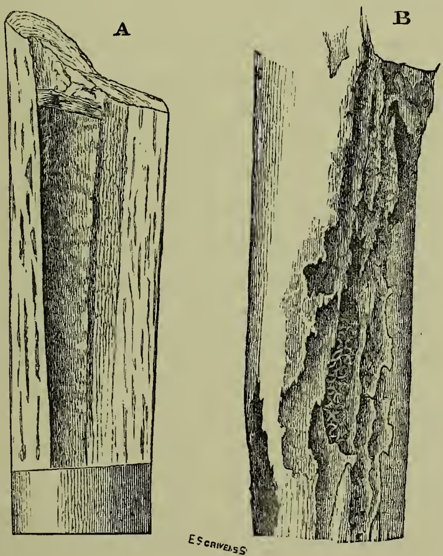

FIG. 2. A.—Section of tibia taken from the bone, removed in a case of *diffuse sclerosis*, showing its compact dense structure, smooth outer surface and open medullary canal, as compared with B, a portion of the tibia removed from the leg of a patient suffering from acute osteo-myelitis (p. 27), showing the destruction effected within the shaft of the bone, together with a portion of its outer layers, which are comparatively healthy.

the same relative proportion as healthy specimens of bone.

From a microscopical examination of this tibia, I find that its canaliculi are almost completely obliterated, and by far the greater proportion of its lacunæ are diminished in size: at the same time the Haversian canals are hardly altered in calibre (see Fig. 2), so that we can understand how the blood circulated through the bone and kept it alive, although it is changed in structure throughout the entire length of the shaft. So long as it remained *in situ*, this hard diseased mass of bone was a source of great disturbance to the nutrition of the surrounding parts, as the following notes, taken for me by Mr. Jaquet, demonstrate:—

J. C., aged ten years, had enjoyed good health until the disease of the leg came on, for the treatment of which he was admitted into the Westminster hospital. Some three months before, he began to complain of deep-seated pain in the right leg. The patient's father and mother are healthy people, and there is no history of hereditary disease.

On admission the lad was suffering from high fever, and intense pain in the right leg, which was much swollen from the knee to the ankle, and of brawny hardness; on running a grooved needle deeply into the calf of the leg, pus escaped along the instrument. I made a free incision, therefore, into the soft parts, but, on passing my finger through the wound, could discover no bare bone;

on the contrary the periosteum was apparently unaffected. The pain and other symptoms were not relieved by this treatment; the fever increased, a considerable quantity of pus constantly passed from the wound, and the lad was evidently sinking from the effects of the disease. It appeared as if nothing short of an amputation at the knee-joint would save the patient's life, but, before resorting to this operation, it was determined to make a further examination as to the condition of the tibia.

On the 15th of June an incision was made along the entire length of the inner surface of the bone, and as the periosteum was much thicker and more opaque than it should be, I cut through it along the length of the shaft, and found that it was very readily separated from the bone. From the appearance of these structures, I thought sclerosis of the tibia had occurred, and I determined to remove the bone, leaving its upper and lower epiphysis and the periosteum in the leg. Considerable difficulty was experienced in cutting through the bone, which was exceedingly hard, confirming my idea regarding the nature of the disease.

From the time of the operation the discharge of pus lessened, and the patient's health rapidly improved; new bone was thrown out from the periosteum, and in six weeks' time the boy left the hospital for the country. I saw him again in September, when he was able to walk about the wards, a mass of firm bone having formed in place of that which I had removed, but a sinus connected with dead bone existed near the upper part of the leg.

Unfortunately our patient contracted small-pox during the early part of November, and, as I subsequently learned, died after nine days' illness in a hospital devoted to the special treatment of that disease.

In the case of J. C., after injecting the nutrient artery as it passed into the shaft of the bone, no evidence of inflammation in the medullary tissues could be discovered. On the other hand, the soft structures contained in the central cavity of the bone were healthy, and the injection was found to pass freely from the main artery into the Haversian spaces which run from the central cavity into the shaft of the bone.

On making sections through the tibia, we discovered that by far the larger number of the canaliculi had disappeared, and the lacunæ were smaller and more numerous than in health, so that any given portion of the shaft of the tibia was only about half as porous as a healthy specimen of bone would have been; and, in sawing through it or grinding it down, the force required to effect our object was in excess of that necessary to operate in a similar way upon sound bone, to the extent of the resistance offered by the surplus quantity of inorganic matter or bone-earth which it contained.

In the early stages of diffuse sclerosis of bone, the canaliculi and lacunæ probably allow a considerable quantity of serum to pass through them.

I do not attempt to explain the nature of the abnormal action which, in the class of cases we are considering produce this increased flow of blood through the part, but its consequences become apparent in the silting-up of the passages through which the serum, holding in solution the bone-earth, circulates, leading to changes in the physical structure of the bone; but the blood still flows through the vessels contained in the Haversian canals, and to some extent through the canaliculæ and the lacunæ: otherwise the bone would evidently have died *en masse.*

We know as a matter of fact that sclerosed bone may live for years—a constant source of irritation and trouble to those who unfortunately possess it, as the following case demonstrates :—

C. B., æt. twenty, was lately in Holland ward, under Mr. Cowell's care ; there was no evidence of hereditary disease in her family. When young, the patient met with an accident by which she injured her right leg, and from that time up to the present the limb has been a source of almost constant pain and trouble, so much so that she has been a cripple for some years past. On admission into hospital, the right tibia was found to be somewhat thicker than that of the left leg, the superficial structures were covered with ulcers and their cicatrices, and there was constant and most severe pain in the limb, but the periosteum covering the tibia was entire, and no necrosed bone could be detected.

After long-continued treatment, Mr. Cowell considered it advisable to amputate the leg at the knee joint. Subsequent to the operation the patient rapidly recovered her health, and soon left the hospital able to walk about on her wooden leg.

The tibia was covered with thickened periosteum, but the surface of the bone was smooth. On making sections through it, we found it was sclerosed from one end to the other, the trabecular network of its extremities being implicated to as great an extent as the shaft of the bone, but the medulla was apparently healthy, and the Haversian system and the nutrient artery have been completely injected through the popliteal vessel.

On examining sections made from the shaft of the bone, we found that the canaliculi were almost obliterated, its lacunæ being greatly diminished in number and size. In this, as in the former case, we can therefore easily understand how it is that the bone continued to live, and we can also comprehend the fact that a heavy hard mass of diseased bone such as this was a perpetual source of pain and irritation to the patient.

We may presume that this sclerosed state of the tibia had in this instance existed for years; nevertheless, as the child grew, her diseased bone continued to increase in size, because its medullary structure and periosteum had remained comparatively healthy, the perverted action occurring not in the bone-forming elements, but probably in the organic matrix of the bone, and so the lacunæ and canaliculi were affected in the manner I have described.

Had the disease been due to an abnormal state of the blood, probably either the vessels or the soft structures entering into the formation of the bone would have presented some abnormal appearances; but they were all, as far as we could ascertain, perfectly healthy.

The condition in which we found this bone reminded me forcibly of the alterations which occur in the cornea as a result of the non-suppurative form of keratitis; in fact, the cornea and the organic material entering into the composition of the osseous tissue are by no means dissimilar in respect to the anatomical arrangement of their soft elementary parts.

In the first case I have related—that of J. C.—it might be argued that the primary seat of disease was hardly in the tibia, for it was possible a deep-seated abscess in the calf of the leg would have so far disturbed the nutritive changes of the surrounding parts as to give rise to the sclerosed state of the bone; but I think if the altered condition of the bone had been produced in this way, we should have found superficial necrosis of the tibia, and the periosteum between the abscess and the bone extensively diseased. The same remark applies to the objection that this might have been a case of acute periostitis.

It seems, with reference to these sclerosed bones, that, whatever the nature of the perverted action which induces the alterations in their structure, its results are different from those arising from either acute inflammation of the medulla or of the periosteum; the former speedily killing the whole of the part affected, and frequently leading to fatal pyæmia; the latter ending in superficial necrosis of the bone, and extensive suppuration in the surrounding soft tissues.

You are aware of the fact that sclerosis of bone occurs in cases of rickets, syphilis, and many other affections, in which the appropriation of the elements contained in the blood by the bone-cells is greater than is required for the maintenance of the healthy condition of the structures through which they flow; but in the class of cases we are considering, it is impossible to determine if the fault originates in the cells, by means of which the integrity of the affected tissue is affected, or if the defect occurs in the blood supply.

It would certainly seem that diffuse sclerosis of bone sometimes takes place in consequence of the circulating fluid, like an overflowing stream, depositing its inorganic elements in all the available crevices and channels through which it passes, silting up the pores which are contained in the osseous structure; and so any cause producing continued hyperæmia of the bloodvessels contained in the whole or a portion of one of the bones may end in sclerosis. If the process occurs slowly, the parts may have time to adjust themselves to their altered circumstances; but if sclerosis occurs suddenly, especially when the growth of the bone has been completed, the nutritive changes going on in the part are necessarily disturbed, and symptoms such as those I have described in the case of J. C. supervene, the course of the disease varying according to the rapidity of the abnormal action going on in the bone.

With reference to this subject Professor Billroth observes that "the causes of sclerosis of bone as a primary disease are entirely obscure; in some cases syphilis may act as a cause, but the osseous formations occurring in this disease rarely attain such firmness as in sclerosis proper. The malady will rarely be recognised with certainty during life, because to the touch these bones present nothing more than a certain increase in thickness and a slight inequality of surface." But sclerosis having once altered the whole or any part of a bone, the diseased structures can never resume their normal condition, and the part continues a source of trouble to the patient.

The acute form of the disease which I have described may readily be mistaken for suppurative periostitis, and until we examine the part by cutting down on the bone, I know of no means by which we can distinguish between these affections; but so far as I can judge, in acute periostitis, the periosteum is speedily destroyed, and the bone having been laid bare becomes rough and necrosed. In sclerosis this is not necessarily the case; as in the instances I have related, on examining the diseased bone, we found its surfaces smooth and encased in comparatively healthy periosteum, and it is upon this fact that the importance of a correct diagnosis depends; for in diffuse sclerosis our aim should be to preserve the periosteum, expecting to get bone reproduced in place of that which we may remove, but in suppurative periostitis we can seldom hope for a result of this kind, and amputation of the diseased limb, or the entire removal of the affected bone, may alone suffice to save the patient's life.

LECTURE IV.

TUBERCULOUS AFFECTIONS OF BONE.

GENTLEMEN,—The following case, reported by my dresser, Mr. Jaquet, affords me a favourable opportunity for discussing the circumstances of scrofulous, or tuberculous affections of the structures contained in bone.

F. C. H., æt. five and a half years, a bright, intelligent, fair-haired boy, has resided all his life in a country village in Oxfordshire. His father and mother are healthy, industrious people, and no direct trace of hereditary disease can be discovered in the history of the family. Our little patient fell from a swing some two years ago, and struck his right knee against a tree. The part became painful and swollen, and has continued to give more or less trouble from the date of the accident up to the time he came under my care. The patient's right leg was then fixed at an obtuse angle on his thigh, there were no sinuses about the joint and it was free from pain, except at night when the child lay awake crying with uneasiness in the knee. The position of the limb was such as to prevent his placing his foot on the ground, and it was considered advisable therefore to divide the contracted ham-string tendons, and bands of fascia in the popliteal space. Having done this the leg was easily extended and retained in position for a month by means of a plaster of Paris bandage. It was subsequently found, however, that his leg from the knee downwards was paralysed. Friction and electricity were persistently employed for five months without benefit; and, in the meantime, the child had gone through an attack of measles and mumps, which told upon his general health; symptoms of more acute disease manifested themselves, the patient's temperature rose every night to 102°, and the joint became painful. Under these circumstances the limb was amputated immediately above the condyles of the femur. The wound healed without suppuration, and the patient left the hospital a month after the operation.

This history gives us the outline of a class of cases, instances of which are to be met with in almost every surgical ward throughout the country. The patients are usually either delicate children or young persons under adult age; as a rule, they are members of a phthisical family, and often present the characteristic features of persons suffering from a scrofulous diathesis. They frequently date the commencement of the disease of the bones from which they suffer to an accident, a sprain, or over-exertion. Under some such circumstances the patient is attacked with deep-seated pain situated in the extremities of one of the long bones, or it may be in the cancellated structure of one or more of the bones of the hand, foot, or vertebral column.

The pain is almost always aggravated by pressure on, or any movement of the affected part. It is worse during the early part of the night, so that a child who has appeared comparatively well through the day will cry for two or three hours after going to bed from pain in the affected limb. The first onset of pain is sometimes prolonged over a period of several weeks; the soft structures round the seat of disease become more or less red and swollen. Although the medulla in the cancellated tissue of one of the long bones may be the structure primarily involved, it is quite possible the synovial membrane in a neighbouring joint may speedily be implicated in the abnormal action going on in the part, and synovitis then becomes the marked symptom in the case. I have no doubt that in many instances in which enlargement of the ends of the bones is said to exist the swelling is due, not to the expansion of the ends of the bone, but to induration and thickening of the synovial membrane and soft structures surrounding the part.

In other cases the advent of the disease is insidious; there is no external inflammation—in fact, the only complaint the patient has to make is that he suffers from a deep-seated gnawing pain. He can hardly tell you the exact seat of the pain; it is somewhere, perhaps, in the foot or heel, but he seldom puts his finger on a peculiarly painful spot. A sudden jog or violent exercise is certain to produce an accession of pain. Under the influence of rest these symptoms subside, to recur, however, within a short period; and so, if one of the lower extremities is affected, as we too often see in cases of hip-joint disease, the patient is confined to his room for a considerable time, he becomes weak and anæmic, the local affection gains ground, the diseased bone rots, and an opening forms through which the disintegrated structure escapes.

On the other hand, we often meet with patients who have suffered from long-continued attacks of pain and other symptoms such as I have described —in the lower end of the femur, for instance; but the symptoms subsequently subside, and the functions of the limb are restored.

In the case of F. C. H. immediately after the limb had been amputated the popliteal artery was injected with carmine, and the knee-joint carefully examined. No pus was discovered in it, the crucial ligaments were healthy; the synovial membrane had been beautifully injected, and seemed healthy. The inner articular facet of the tibia was covered with cartilage, its central portion, however, being reduced to an extremely thin layer, beneath which numerous spots of extravasated vermilion were perceptible, the cartilage surrounding this central portion had a glistering healthy appearance. The articular surface of the inner condyle of the femur (only partially injected), was, over its central portion, covered with hard nodular projections of bare bone, but the surrounding cartilage was healthy. The articular surface of the outer condyle of the femur was more extensively diseased, for the free surface of the bone recently formed from this epiphysis was rough and denuded, but this central ulcerated portion of the bone was enveloped by a thin border of cartilage, which was normal in structure on its free surface, although its deep surface was separated from the growing bone by a layer of granular cells; the cartilage surrounding the articular facets was healthy. The outer articular surface of the tibia was in much the same condition as that of the corresponding portion of the femur, but in addition we found a cavity filled with a jelly-like substance passing from its free surface through the epiphysis into the shaft of the bone.

It was evident from the condition of the synovial membrane that the disease of the joint had not commenced there, the articular surface of the bone being subsequently implicated, for not only was the synovial membrane comparatively healthy, but the cartilage surrounding the articular facet of the bones entering into the formation of the joint were normal in structure. Not a single vessel could be traced from the synovial membrane through the outer healthy portion of the cartilage to the central diseased part. The fact is the articular cartilages mainly derive their blood supply from the vessels contained in the cancellated structure of the bone to which they are attached, and in the bones of children there is no calcareous lamina to separate the medulla of the bone from the articular layer of cartilage.

If we examine sections made through the diseased portions of these cartilages we find that in many places a thin stratum of normal cartilage lines their free surface, but that between this and the growing bone there is a layer of granular cells which are evidently continuous with a similar spawn-like tissue filling much of the cancellated spaces in the bone. In these perforations, therefore, there is evidence as to the fact that the abnormal condition of the cartilage did not commence on its articular, but in its attached or deep surface, and that the diseased action had spread from thence outwards towards the joint.

I do not deny that ulceration of the free surfaces of these cartilages exists in isolated spots, and that the base of these ulcers is formed by healthy cartilage, so that at first sight we might conclude that the disease had begun on the articular surface of the cartilage; but if we make sections through these ulcers down to the osseous formation in the epiphysis, we find that under the layer of cartilage forming the base of these ulcers there is a crop of granular cells, such as I have before referred to, growing from the medulla into the cartilage, and so altering the nutrition of the cells at the surface of the cartilage; but in this superficial degeneration of cartilage there is none of the spawn-like tissue to be found which, in these specimens of the deeper layers of the cartilage, appear in such abundance.

It is important to notice the difference between the fibroid changes which so frequently occur in articular cartilage, and the degeneration which takes place in it from the growth of cellular elements springing from the medulla, and which interferes with its nutrition. We find that the growth which has invaded the cartilage from the bone consists of a multitude of round granular cells, among which are some large compound cells, and throughout the new growth, a stroma of hyaline fibres can be demonstrated; there are few, if any, vessels to be seen in this fibro-cellular mass; but if we examine it in the cancellated spaces of the bone we find that it is intimately connected with the outer coats of the smaller arteries, growing as a nodulated mass from these vessels. These nodules are closely invested by healthy medullary tissue.

The new growth, as I have already remarked, possesses very few vessels. This rule holds good, too, with reference to those cancellated spaces in the bone which are wholly occupied by it. I believe it is from the pressure exercised by this over-abundant cellular formation against the rigid wall of the bone, that the circulation in the vessels is interfered with; and when once the circulation is impeded, the elements of the new growth pass into a state of fatty degeneration.

If we examine these injected sections through the epiphysis and shaft of the bone, after they had been soaking for a month or six weeks in glycerine and chromic acid, we see a number of small opaque spots in the cancellated structure, composed of degenerated fibro-cellular tissue, such as that which I have above described, and the cavity passing from the articular surface of the outer facet of the tibia into the shaft of the bone has evidently been produced in this way. The contents of this cavity are jelly-like in consistency, and on making transverse sections through it, and into the surrounding osseous tissue, we find that its circumference consists of spawn-like tissue, continuous with that in the cancellated structure of the bone, the vessels also passing from the medulla a short distance into the jelly-like substance, and there terminating by anastomosis; but the central part of the cavity is occupied by disintegrated cells and fatty matter, in which there are no vessels. You will also observe that there is an entire absence of anything approaching to new bone formation, or sclerosis, round this cavity, or anywhere else in these specimens.

We may therefore fairly conclude, that the cancellated tissue of the bones entering into the formation of this diseased knee had, during life, been occupied by an abnormal fibro-cellular formation, which had not only invaded and destroyed the articular cartilages, but had also produced the cavity in the tibia, and the death of certain portions of the bone, by impeding the supply of blood to the part, and so inducing softening and fatty degeneration of the tissues, which are finally washed out of the bone by the stream of fluid percolating through it from the surrounding vascular area. For you must distinctly understand that in the living bone the parts beyond a cavity such as I have described are extremely vascular, and it necessarily follows, that when the tubercle breaks down and forms, as it were, a well in the centre of the bone, the surrounding fluid will drain into it. There must ultimately be an outlet for this pent-up fluid, which escapes therefore through the passage of least resistance—it may be into a joint, or externally through the skin; but we cannot doubt but that the constant drain of fluid from the more healthy through the diseased tissues greatly influences the condition of the latter, and it seems reasonable to suppose, that if by any means we could control the supply of blood to the parts, we might modify the abnormal action going on there.

From another specimen I have here, you may notice that a considerable number of fibro-cellular patches similar to those we have just been discussing may, in place of degenerating into small abscesses, undergo calcareous changes. In this preparation, taken from the end of the tibia of a young woman, whose leg I amputated on the 27th of May, a cavity extends from the lower articular surface for an inch and a half upwards towards the medullary canal.

In the fresh specimen, the bone surrounding this cavity was extremely vascular (fungating caries). On making thin sections through the bone, and soaking them in glycerine, we notice a number of opaque spots, about as large as a No. 3 shot, situated in the cancellated tissue, and on further examination we find that these opaque spots consist of extremely hard nodules of calcareous matter, which lie in a structure composed of a fine reticular network of adenoid tissue, its meshes being crowded with round cells resembling lymph-corpuscles (spawn-like); besides these cells, there are innumerable free nuclei filling up the interstices between the cells; the periphery of these nodules and their envelope is sharply defined, the surrounding medulla being normal.

We have evidently, therefore, in this specimen an example of tubercle which has undergone calcification in its centre.

On making a further examination of these sections of bone, we observe several non-vascular, opaque, grey, and soft patches, about the size of a split pea; and under the microscope we discover that the outer layers of these formations consist of precisely the same elements as those which surround the calcareous deposits, but the centre of these opaque patches contains disintegrated osseous and fatty matter. In fact, the tubercular growth has liquefied, and there seems no reason to doubt that the large central cavity in this tibia has been formed by a precisely similar process, there having in the first instance been a growth of tubercle in the cancellated tissue of the bone, which had undergone degenerative changes, its liquid contents ultimately escaping into the ankle-joint.

In the first case I brought to your notice (F.C.H.), it seems as though the diseased action had been excited by the injury our patient had received; the nutritive changes in the soft parts entering into the formation of the cancellated tissue of the bone had then been interfered with. Doubtless an abnormal process such as I have described is greatly influenced by inherited constitutional defects which the tissues may have acquired, but there is no reason whatever to suppose that abnormal cell-growths of the kind cannot arise independently of inherited faults. In the case we are investigating, it is quite possible the law of interrupted transmission may have affected the issue, for although we could discover no history of constitutional disease in the lad's family, his ancestors may have acquired a fault by means of which structures entering into the formation of their body, had become predisposed to the rapid overgrowth of certain elements, and it only wanted in the case of this child an injury such as he received to upset the balance of the nutritive changes going on in the bone, to bring out prominently the defect in the organization of the medullary tissue.

I cannot agree with those who consider fibro-cellular formations in bone of this kind to be the result of ordinary chronic inflammation, leading to granulation tissue, because I think inflammation could hardly exist in the contents of the cancellated tissue of a bone for two years without causing enlargement or sclerosis of its trabeculæ, and the formation of new bone, or else the products of the inflammation would have engendered pus in the part; but in these specimens there is an absence of the characteristic effects of inflammation. I admit that I cannot define the distinctive features between the fibro-cellular formation constituting the disease I have described to you and those which are usually considered as granulation tissue; but there is nevertheless a difference between them, for the tendency of granulation tissue is towards suppuration, but that of the growth I have described is unquestionably towards degeneration, and in this respect, as well as in its structure, it so much resembles tubercle that we have every right to consider the disease with which we have to deal as being tuberculous in its nature.

An authority on these matters observes in a recently published lecture, that "although the pathology of many of these cases is obscure, the doubt is practically of slight importance; for, in respect to treatment whether they are scrofulous or whether they are not, one law must be rigidly observed, that is the law of absolute rest." I cannot concur in these views, for I think that to arrive at an accurate idea of these affections of the bones is a matter of the first importance with reference to treatment, for if these diseases depend, in the majority of cases, on local injury—being, in fact, the result of a blow or contusion occurring in a healthy child—then it seems reasonable enough that the parts should recover their normal condition if kept at rest. On the other hand, if the majority of these affections of bones depend on constitutional defects, which we have good reason for believing, can only be overcome by means of an unlimited supply of sunlight, pure air, and food ; then, valuable as rest may be as a therapeutical agent, it is nevertheless only an adjunct (and too often, in my opinion, a misused one) in the treatment of the formidable class of diseases we have been studying.

I shall refer to these matters again, and will only observe at present that, it seems to me, if these affections of bone are only the result of contusions it is impossible to explain how it happens that the children of the natives of Bengal, for instance, rarely suffer from disease of this description ; but, supposing these diseases depend on tuberculosis, we can understand the immunity of native children from affections of the kind, because scrofula is not common among their parents. The argument may be carried a step further, for if affections of the bone, such as we are discussing, depend on contusions, but few children should escape joint-disease, considering the innumerable falls and accidents which our little ones must meet with before they are four years of age.

I have lately received a most valuable work by Dr. V. P. Gibney, of New York, on "the strumous element in the etiology of joint disease, from an analysis of eight hundred and sixty cases." Dr. Gibney asks the question, Can joint disease occur in a non-strumous child? Among others, a no less distinguished surgeon than Professor S. D. Gross replies, with reference to the hip joint, that, in his opinion, "the disease could not occur in any man, woman, or child, unless a tuberculous diathesis were present." Dr. Gibney, after an exceedingly fair and judicious summary of his eight hundred and sixty cases, remarks of joint disease, whether traumatic or non-traumatic, that they gave, with one or two possible exceptions, histories, the facts connected with which proved conclusively, at least the existence of a strumous element in the etiology, and established, as far as facts and figures can establish it, the untenability of the traumatic theory of bone disease as generally understood.

LECTURE V.

TUBERCULOUS DISEASE OF THE BONES (*Continued*) —LYMPHADENOMA.

GENTLEMEN,—I have another case I wish to bring to your notice before proceeding to consider the more general questions concerning tuberculous disease of the bones. You may remember, last September, seeing a little girl (G. W.), aged six, in the Chadwick ward, suffering from angular curvature of the spine and a large pelvic abscess connected with diseased vertebræ. After death we found that the bodies of several of the dorsal vertebræ were in a condition which is commonly described as "fungating caries." After making sections through these vertebræ, we see that in places the contents of the cancellated tissue are of a deep crimson colour, especially along their anterior free surface, where the bone has been partially destroyed, and presents a soft, florid (granulating ?) appearance.

On examining specimens of the material contained in the diseased cancellated tissue, we find that it is composed of precisely the same fibro-cellular growth I have described in my last lecture as characteristic of tubercle, and that by far the greater part of the medulla in these bones has been replaced by a similar formation ; in fact, the cancellated structures of these vertebræ are choked by a lowly organised fibro-cellular growth, which towards the anterior surface of the bone has degenerated, and the disintegrated osseous tissue, together with the remains of the structures through which it has passed, have penetrated along the line of least resistance, and so reached the right groin.

But you will observe that in this instance, as in the case of F. C. H., no new bone has been formed in or around the seat of the disease, perhaps for the simple reason that tubercle having replaced the medulla, none of the original embryonic elements are left from which new bone could have been produced.

This case therefore differs essentially from one of ordinary inflammation, in which, unless the abnormal action has run a peculiarly rapid course (as in acute osteo-myelitis), the increased energy manifested by the cells contained in the medulla, results in the formation of new bone, by means of which a limiting membrane, if we may so call it, is formed round the focus of the disease (see page 143). In tubercular affections there is but little chance of any such conservative action, for not only are the normal elements of the medulla destroyed, but the healthy medulla, which we know in the greater number of cases surrounds the diseased tissue, fails to throw out new bone, until the tubercle has completely degenerated, and is removed either by nature or by the hand of the surgeon. The rough treatment which a bone receives under these latter circumstances, sets up a very different action from that caused by an insidious disease like tubercle, which seems to destroy the tissues among which it forms by appropriating their nutritive fluid to its own purposes.

In consequence, however, of the want of energy in the bone-producing elements, around tubercular formations in the cancellated structure of the long bones, the products of the disintegrating tubercle are swept towards the subcartilaginous layer of bone; the processes leading from the cancellated tissue to the articular cartilages become blocked, the latter structure atrophies, and so joint complications arise; in the meantime the tubercle continues to grow, the tissues around it crumble away, liquefaction of the tubercle follows, and the matter, as I have already described, is carried by drainage through the part, perhaps into a neighbouring joint; in this case of diseased vertebræ, it "pointed" in the thigh.

Beyond the fact of there being no new bone formed in these cases of diseased vertebræ (and the same remark applies to all the specimens I have shown you), the trabeculæ in the cancellated tissue are not rendered denser (sclerosed), as they are in instances of chronic inflammation of bone.

This is one of the broad and characteristic features between tuberculous specimens of bone and those resulting from ordinary inflammation. In the latter, from the nature of the abnormal action going on in the part, sclerosis of the bone occurs to a greater or less degree (page 143), whereas in tubercle of bone the trabeculæ, in place of becoming denser, are generally unaltered, or, if changed, become more spongy than in health. I have explained the reason of this to you, and I lay stress on the point because it is argued that the condition of the medulla I have described as due to tubercle may be the result of chronic inflammation, and the cell-growth simply granulation-tissue. I say no. If granulation-tissue cannot be distinguished from tubercle under the microscope, nevertheless the condition of the surrounding parts which results from these forms of disease is very different, and enables us to diagnose the one from the other. It is true that in instances of tuberculous disease of the bones of the foot and ankle joint, for instance, we sometimes find the osseous tissue of the tibia and fibula beyond the site of disease are sclerosed from the effects of the long-continued hyperæmia which has existed in the part; but we must not suppose the enlarged and condensed bone produced in this way bears any more direct relation to the disease which has induced the distinction of the parts below it. The sclerosis, under these circumstances, is the result of the engorgement of the vessels contained in the medulla and the soft parts surrounding the bones.

With reference to the idea that the affection I have described as tuberculosis of bone is a constitutional disease as distinguished from a local one, I would again draw your attention to the work of Dr. Gibney already referred to, in which he demonstrates that the clinical history of a large proportion of these cases gives us clear evidence as to the patients having been members of a phthisical family, or that some of their near relations had suffered from tuberculosis.

Then, again, how often we meet with instances of disease of this description commencing in one bone, and before long appearing in a neighbouring bone, separated, perhaps, from the original focus of disease by a joint. The abnormal action in these cases does not extend through continuity of tissue, but probably from the fact that the first manifestation of the disease had been engendered as the result of some cause or other which interfered with the nutrition of structures prone to develop tubercle. The disease having once become established, chronic hyperæmia occurs in the part, and so the nutritive process in neighbouring tissues is interfered with, and the growth of tubercle in parts near the starting-point of the disease is the result. This idea rather leads us to assume that in these cases the cytogenous connective tissue at the seat of the disease, and probably in other parts of the body, is prone to tubercle, in consequence of inherited tendencies. It simply requires some slight extraneous agency to act on this structure to set latent forces at work leading to the formation of tubercle, which too commonly continues to grow until it has destroyed the structures it first manifested itself in.

Again, this notion that these affections depend on constitutional disease is strengthened by the fact that in countries such as Hindostan, where phthisis is not so common as it is among the inhabitants of Europe, scrofulous diseases of bone are less frequently seen. I hardly remember meeting with a case of scrofulous disease of the bodies of the vertebræ in a native of Bengal, and Sir J. Fayrer, writing to me on this subject, remarks: "Strumous disease of the bone is less common in the natives of India than in those of this country. Joint operations are consequently less frequent also, but I can recall cases of hip, elbow, and ankle, and also of tarsal and the ends of the long bones, in which it existed. Far less, though, I think, than here." By the same reasoning it seems doubtful if the affection of the bones we are considering depends on a syphilitic diathesis, because this latter disease is widely diffused among all classes of India; but, as I have above remarked, scrofulous affections of the bones are not common among these people.

On the other hand, it is argued that the cases are so numerous in which molecular disintegration is limited to a single bone, and often to only a small portion of that bone, that it seems hardly possible to suppose the disease can depend on constitutional defects; it is further with truth asserted that the removal of the local manifestation of disease of this kind appears frequently to put an end to the abnormal process—the patient is, in fact, cured by taking away the diseased tissues. In answer to this, I think that, for instance, in excising a diseased knee-joint (scrofulous), we do little more than remove the palpable effects of disease; it is quite impossible to assert that in even the majority of cases so treated the diseased structures are entirely excised, for it seems most certain that in cases of scrofulous children certain tissues throughout the body are very liable to be invaded by tubercle; in one instance, in consequence of faulty surrounding, the lungs become involved, in another the osseous tissue, and so on. In fact, as with individuals, so with their tissues, the weak or susceptible parts most readily fall victims to deleterious influences, and so doubtless contusions, or other injury to bones entering into the formation of joints is frequently the starting point of tuberculous affection in the osseous tissues of those who are predisposed to disease of this kind.

There must be degrees of healthiness, however, even in the tissues of phthisical people, and so those tissues most prone to tuberculous disease in scrofulous subjects pass into decay, but it does not follow that the remaining structures are healthy. The surgeon may remove parts that are evidently rotten, and the result is beneficial—precisely what we should have anticipated in the case of constitutional disease, because the traumatic injury done to the tissues produces a new, and in this instance a conservative action in them, and often clears away obstacles to the efficient drainage through the parts, relieving the congested structures; and further, anything which tends to lower the patient's general health, such as the irritation and discharge kept up by a diseased and rotten bone, if removed, must be advantageous; and unquestionably by removing local disease, and thus perhaps enabling a weakly patient to take out-door exercise and breathe fresh air, we greatly improve his prospects of recovering health and strength, and so diminish the further tendency he has to develop tubercle.

These considerations are of importance, for it is not by simply studying the anatomical and pathological changes which have occurred that we shall gain a thorough knowledge of the circumstances of tuberculous disease of bone; we are evidently also bound to exercise our minds upon the conditions which influence its progress during life, and none of these is of greater importance than the fact that tubercle being a constitutional disease, depends greatly upon hereditary, and hygienic imperfections for its development and growth.

That chronic inflammation of bone may occur independently of tubercle is well known to every surgeon; but because this is the case it is hardly correct to argue that tuberculous disease of bone is a rare affection. We do not know why tubercle should more frequently occur in the lymphglands of children than of adult persons, but such is the case; and so it is with the medulla of bone, and if in the class of cases I have described we search for tubercle in this tissue we shall, unless I am much mistaken, not unfrequently find it there; and I think I may add in the periosteum also. The following case seems to point to this fact:—

G. R., æt. twenty-two, was admitted into hospital on the 29th of February; he gave us a history, and had the marks of, strumous disease of the cervical glands; *he had never suffered from syphilis,* and without any known cause, about six months ago, he noticed a hard painful swelling, which gradually increased in size on the upper part of his right shin-bone.

On admission into hospital an extremely painful swelling was found to occupy the whole of the upper part of the tibia, the skin covering it was deeply congested, and appeared to be involved in the tumour, which was considered by two of our staff to be in all probability a malignant growth involving the head of the bone. The lymphatic glands of the groin were not swollen, and the patient, although emaciated and worn out with pain from which he had suffered, did not present the appearance of a person affected with malignant disease.

A grooved needle was run into the tumour, nothing but blood exuded along its sides; an incision was made through the growth down to the bone, and a quantity of caseous material was pressed out of it; the bone beneath, though rough, was not necrosed.

Poultices were subsequently applied, and a very considerable quantity of gritty caseous material exuded from the wound, which in the course of time healed, and the patient in two months left the hospital perfectly cured.

This case is interesting, as it appears to point to the fact that an affection of the periosteum, very similar, if not identical, with that I have described as tuberculous disease of the medulla, may occur, for in this instance we could gain no history or evidence whatever of syphilis, otherwise the disease might justly have been considered as being a gumma of the periosteum.

LYMPHADENOMA (HODGKINS' DISEASE).

We seldom meet with cases of this affection in our surgical wards, but I may refer to the disease in connection with tuberculosis, as I have lately had an instance of the kind under my care in the hospital.

J. N., æt. nine, was sent into the hospital by Mr. Goldie, medical superintendent of Stepney Sick Asylum, an institution which it is well worth your while visiting, for I have seldom seen an establishment for the sick more perfect in its arrangements or more efficiently conducted. Our patient had been under Mr. Goldie's care for about a year: he was a fair-haired, blue-eyed, intelligent lad, and although suffering from enlargement of the cervical glands on the right side of his neck, his general health was good until some six months ago, when the glands commenced increasing in size very rapidly. J. N.'s family history pointed to the fact of his having inherited a tuberculous diathesis. On admission into our hospital five months after the commencement of the rapid growth of the cervical glands, the patient was extremely blanched; the whole of the right side of his neck was occupied by a large tumour which felt like a firm sarcomatous growth, with here and there soft patches scattered throughout its substance; the skin over the tumour was healthy and freely moveable over the morbid growth, which had hardly caused the patient any pain.

The lymphatic glands on the left side of the neck were greatly enlarged, as were the glands in the patient's axilla, as well as those in front of the elbows, groins, and popliteal spaces. There was no enlargement of the liver or spleen, no albumen in the urine, nothing abnormal in the choroid or retina; the heart and lungs were healthy; there was no anasarca or dropsy; the patient's blood was very carefully examined, and there was found to be no increase in the number of white corpuscles which it contained.

Soon after admission into hospital the patient was seized with pleurisy; his breathing and deglutition had previously been much impeded by the pressure of the tumour on the trachea and œsophagus, and he speedily sank under the increased difficulty in respiration caused by the effusion into the pleura.

On making a *post-mortem* examination we found that not only were the glands above mentioned greatly enlarged, but the œsophageal, bronchial, mesenteric, and in fact all the lymphatic glands in the body, were hypertrophied.

The tumour occupying the right cervical region was composed of a mass of enlarged glands; in places, however, it was soft and almost gelatinous. The liver and spleen were of normal size and colour, with the exception of a number of yellowish-grey nodules scattered over their surface; from these nodules processes passed into the parenchymatous structure of these organs. Over the base of both lungs similar growths were observed.

The kidneys and supra-renal capsules were healthy.

I injected the vessels of this patient's right tibia through the femoral artery, and I now show you the specimens thus obtained. You will observe that the vermilion injection has filled the vessels of the periosteum, the nutrient arteries, and the vessels contained in the Haversian canals of the compact tissue of the bone, but it has failed to penetrate into the blood sinuses contained in the medulla of the cancellated tissue. On examining sections of the bone, we find that its cancellated structure is choked by a dense fibro-cellular tissue which is precisely similar in appearance to that seen in the gelatinous portion of the tumour in the neck. I believe it is by the pressure exercised by this cellular growth (confined by the unyielding bone) on the vascular sinuses which has prevented the injection entering these channels; and if so, it is probable the circulation of blood through them must have been impeded during life, so that we have here in the medulla a condition analogous to that which I have described to you as existing in cases of tubercular disease of the bones. With the naked eye we can see patches of the fibro-cellular formation, some of considerable size, in the medullary canal; they look very like what they have often been described as resembling in other parts of the body—small lumps of suet, being in fact hypertrophied portions of the normal elements contained in the cancellated tissues and medullary canal of a growing bone.

Holding, as I do, that the deep layers of the periosteum, and the medulla of bone, are derived from cells originally contained in the temporary cartilage, it is interesting to observe in this specimen that the periosteum in contact with the shaft of the bone is crowded, like the cancellated spaces, with round cells imbedded in adenoid tissue.

Although the hard portions of the tibia have not as yet suffered from the abnormal condition of the medulla which it contains, nevertheless, had the patient lived, it seems probable, in consequence of the defective supply of blood passing through the cancellated tissue, that it would ultimately have degenerated and broken down in precisely the same way as we have seen occur in cases of tuberculous disease of the bones; in truth it appears that the characteristic features of lymphadenoma much resemble those of scrofula. It may be modified by syphilis or some other constitutional taint, and, as I have said before, the condition of the medulla is identically the same in these affections, so far as the naked eye and the microscope enable us to observe them.

I may further remark that in leukæmia accompanied with enlargement of the spleen, generally the effect of malaria, the patient often being anasarcous, and his blood always containing an excess of white corpuscles, the condition of the medulla is different to that seen in this case of Hodgkins' disease, for in instances of advanced leukæmia from the above cause, even in growing bones, we find the blood sinuses of the cancellated spaces crowded with rows of white blood-corpuscles —injected, I might almost say, with them; and the round cells of the medulla are comparatively few in number, the space they should occupy being filled with fatty matter.

LECTURE VI.

TUBERCULOUS DISEASE OF THE BONES (*Continued*) —TREATMENT.

GENTLEMEN,—The following case illustrates the outline of treatment which may generally be adopted in the earlier stages of tuberculous disease of bone.

An intelligent, pale, bright-eyed boy, eight years of age, in whose mother's family phthisis existed, was sent to me under the following circumstances. His general health had been good up to the present time. About six months ago he began to complain of pain in his right heel, which was increased by exercise. The idea for some time was that the pain was due to rheumatism, but the symptoms persisting and the lad being unable to run about with his companions, further advice was thought to be necessary.

On examining the right heel there was no external indication of disease; there was nothing wrong with the joint, but on making firm pressure over a particular spot on the outer surface of the os calcis, the child at once exclaimed that the seat of pain was there, and on stamping the heel on the floor, pain in the same spot was complained of, although, as he explained, when walking, the uneasiness from which he suffered seemed to be diffused over the heel.

He had been confined to the house on several occasions for three or four days together within the past six months, on account of symptoms such as I have described.

I am aware that in a case of this kind the diagnosis is open to question, and could only be arrived at after carefully watching the case for a month or so; but my opinion was founded on the family history, and the long-continued fixed pain in the heel, which on examination was discovered to be confined to a definite spot in the os calcis.

In a case of this description, believing as I firmly do that tubercle in its early stages may be cured, it was of course out of the question ordering the child rest in the way of confining him to the house; for supposing the symptoms he complained of were due to the growth of tubercle in the cancellated tissue of the os calcis, evidently fresh air and exercise were needed to invigorate the child's general health, and so stay the progress of the disease. At the same time it was equally important to preserve the heel from concussion or injury, and this we have endeavoured to do by ordering boots for the boy, made so that the os calcis will rest on a broad flat surface. The sole of the boot is of india rubber, and lined with felt. The object of this is to give the bones of the foot freedom, to have no unnatural pressure on the os calcis, and by a light elastic material for the foot to rest on, to preserve it as far as possible from concussion. Coarse woollen stockings were recommended, not only to keep the foot warm, but to act as a pad to the inside of the carefully made boot. The lad was cautioned not to run or jump, but to take regular walking exercise.

Counter-irritation, in the form of tincture of iodine, was to be continued for a considerable time, together with cod-liver oil, and country air, the patient residing if possible on a chalk or gravel soil, and being protected from chill by flannels and careful management.

We may take a second case at present under observation. A lad, twelve years of age, with a history of phthisis on the father's side, after over-walking himself some two years ago, was seized with great pain in the left ankle. The part became inflamed, and the lad was unable for several weeks to put his foot to the ground. These symptoms subsequently subsided, to recur, however, after a short interval; and so matters have gone on. The patient has consulted several eminent surgeons, and they agreed that the lower end of the left tibia is diseased, and that nothing but absolute rest and patience could be of any use. Acting under this advice, the boy was never allowed to put his left foot to the ground.

From want of exercise, and an in-door life, the patient's health began to fail; and towards the commencement of last summer it was a matter for serious consideration if development of tubercle had not commenced in his lungs, and it was at length determined to treat the local disease as being of tuberculous origin, and depending therefore upon constitutional defects, which were most likely to be overcome by out-door amusements. As the lad could not take much active exercise on foot, he was taught to swim, and very soon became an expert in the art; he also took to riding, and rowing, and was permitted to walk about whenever the absence of pain in the leg would allow him to do so.

Under treatment such as this, the patient has wonderfully improved in health and spirits, and his leg is certainly no worse than it was a year ago, though he still suffers from attacks of pain, which lay him up for four or five days at a time, after which he takes to walking again; his own impression, and that of his friends, is that exercise such as I have described does not increase the frequency or violence of the attacks of pain in the leg.

I think, if we consider the matter, aided by the knowledge I have endeavoured to inculcate, it seems probable that walking would not augment the local symptoms in a case of this kind, for the ankle-joint is evidently not as yet involved in the disease, but the medulla contained in the cancellated tissue of the lower end of the tibia is, we believe, at fault.

The disease, however, is not in the osseous framework which supports the body; this, even in the affected end of the tibia, is, we have reason to think, not implicated in this case, for liquefaction of the tubercle has not as yet taken place. In walking, therefore, I suppose that the diseased medulla is not pressed upon; its bony framework, as in the case of the brain, is a protection to it. No doubt exercise, by increasing the supply of blood to the part, may distend the medullary vessels and sinuses, and so perhaps produce pain in the part by pressing on the diseased medulla; but even if this were the case, it is doubtful whether the augmented blood-supply in this stage of the disease might not be useful rather than otherwise.

It is upon these principles that I think Thomas' splint, and the plaster of Paris bandage, in the early stages of hip-joint disease and in affections of the ankle and knee-joint, are so useful. I wish I had words at my command, to express to you my strong feelings, regarding the importance of allowing patients suffering from incipient symptoms of tubercular disease of the bones to move about, without injurious pressure on the affected tissues, and thus procure that, without which they cannot be restored to health—air, and light. To me it is a pitiful sight to see patients of this kind confined in the close rooms, or the wards of our London hospitals, at rest, until they have passed into a hopeless condition of general ill-health.

The question as to how much exercise may be allowed in instances of tuberculous disease of the bones of the lower extremities is a matter of the greatest importance, and I believe the simplest solution of it is to leave the matter in the hands of the patient, his own feelings and sensations, however young he may be, being the surest guide we can follow.

If a child suffering from disease of the bones of the leg or foot is disposed to run about, by all means let him do so, protecting, however, the weak part as much as possible from injury by mechanical appliances.

And this remark is applicable to diseased bones other than those of the lower extremities. For instance, a child was brought to us the other day with "something peculiar about his neck." On examination, it was evident the long-continued stiff neck complained of was caused by rigidity of the cervical muscles, due to tuberculosis of the bodies of the upper cervical vertebræ. Any movement of the little patient's head or concussion of the spine caused the child considerable pain. The patient was laid in bed for a few days, and then Sayre's bandage and back splint were applied ; the little patient was at once able to get up and go about the wards without the slightest pain, and was sent into the country, where he gradually recovered health and strength.

With reference to this kind of support, I consider the profession is under a great obligation to Dr. Sayre, of New York, for introducing the plaster of Paris bandage (applied whilst the patient is suspended) to cases of tuberculous disease of the vertebræ. I have employed this system of bandaging or support in a considerable number of cases, and the result has been much more favourable in my opinion, than any other means of support that I am acquainted with, especially in instances of recent disease occurring among young persons, in fact, in precisely the class of cases in which diseases of the spine are so difficult to treat. An objection has been raised to "Sayre's" system of bandaging, because, it is argued, nothing but harm could arise from suspending a patient if the vertebræ have become anchylosed. But I need hardly remark that anchylosis of the vertebræ does not take place so long as tuberculous disease of the vertebræ is actually progressing, the condition in which, above all others, we claim for Sayre's plan a superiority above any other treatment. But the author of this system hardly proposed that it should be applied to cases of anchylosis of the bodies of the vertebræ.

Care is required in adjusting the plaster of Paris bandage, not to have too much pressure over the prominent spinous processes of the diseased bones, otherwise the skin covering them is apt to ulcerate, and give rise to considerable trouble. There can be no question as to necessity for fixing the bandage well round the pelvis as a base of support to that surrounding the trunk; but the practical details connected with this system of bandaging can only be learnt by practice in the wards of the hospital.

The same principal may be most advantageously applied to diseased joints. For instance, in the case of hip disease, extension having been kept up for some time, and while the extending force is still applied, so as to keep the head of the diseased bone from pressure against the acetabulum, a plaster of Paris bandage may be applied from below the knee, round the limb, and over the pelvis, thin strips of tin being inserted between the folds of the bandage. If skilfully applied while extension of the limb is kept up, a bandage of this kind is frequently of the greatest comfort to the patient, enabling him to move about on crutches or with a stick without pain. I find that many patients prefer the plaster of Paris bandage to Thomas' splint.

In many instances of incipient tuberculous disease of the bones, I believe accurately applied leather strapping round the affected part is useful; the pressure seems to prevent the soft parts around the bone becoming indurated and unhealthy, and I cannot help thinking, that by means of tightly applied dressings we can regulate the blood-supply to the diseased bone. But, whether this idea is correct or not, my own experience is that tight strapping with leather in cases of this kind is an aid to treatment not to be neglected, and it can, of course, be employed in conjunction with the principles upon which Sayre's splint is founded. The strapping often causes a good deal of pain during the time of, and immediately after its application; but the patient subsequently experiences relief, and is better able to move about. We have lately had several instances in the wards demonstrating the advantages to be derived from this treatment. It is not to supersede the rules I have already laid down in the management of these cases, and much less is it to be relied upon alone as a method for curing cases of this kind.

A plan of treatment formerly much resorted to for the cure of scrofulous disease of the bones seems to have dropped out of fashion of late. I refer to the actual cautery applied over or as near as practicable to the seat of pain, before liquefaction of the tubercle has occurred; severe counter-irritation of this kind is often a valuable curative measure, and is hardly employed with sufficient frequency at the present day in instances of this form of disease.

Supposing a patient applies to us with tuberculous disease of one or more bones which have degenerated into a soft, putty-like matter (not pus), which has forced its way beneath the skin, we then have to deal with an elastic swelling or chronic abscess, as it is often called. If the collection of matter is connected with a single bone—as, for instance, with the first metatarsal bone,—it is well to let the tubercle in the bone continue to break down and destroy itself, but we should be careful not to open the abscess so as to admit the external air into the part, which would set up putrefaction, and entirely alter the nature of the process going on there. I advise you to protect the inflamed skin, and preserve it intact as long as possible, in the way we have been doing in the case of F. W., now in the Chadwick ward. When you find there is no chance of preventing the skin from giving way, make an opening into the abscess, and allow the degenerated tissue to escape, closing up the puncture with collodion and cotton-wool.

If there is clear evidence that the ends of one or more bones entering into the construction of a joint are affected with tuberculous inflammation, the disease having passed on into the stage of disintegration of the tissues, the joint also being affected, what are we to do then? There are some few surgeons who believe that scrofulous affections of bone never get well; and, under circumstances such as I have described, they would advise amputation or excision of the diseased joint. But it is remarkable how much may be done by means of patience and favourable hygienic circumstances in the case of young persons. The following case, reported for me by Mr. W. Quicke, illustrates a system of treatment we have found advantageous in this class of cases.

J. G., æt. thirteen. The boy's mother is a very delicate woman, and his brothers and sisters strumous-looking children. Our patient is a fair-haired lad, extremely pallid, with enlarged cervical glands, and precisely the subject one would expect to see pass on into a phthisical condition. Some two years ago he sprained his ankle while running, and, although he was subsequently able to walk about, it caused him pain, and at length he was obliged to go to an infirmary, where he remained in bed for four months. From that time up to the present the ankle-joint has continued swollen, and he has been unable to put his foot to the ground. On admission, we found the lower extremity of the right tibia was extremely painful on pressure, the ankle-joint was distended with fluid, and the ends of the bones were denuded. The boy was in very great pain and suffering from constant fever. On the 27th February, the patient being under chloroform, I opened the ankle-joint freely under the carbolic spray, and, at the same time, bored a hole from within outwards, and another from before backwards through the lower end of the tibia, and then passed horse hair drains into these openings and laid others through the joint; at the same time I divided the tendo Achillis. The wounds were dressed antiseptically, and, from the time of the operation, the patient's condition gradually began to improve. I kept the drains in the bone for six weeks.

J. G. was subsequently sent to Margate for a month, and then to Walton for two months. He is now able to walk; and I believe we shall not only save the foot, but that he will regain almost perfect use of the limb.

You have seen precisely the same treatment carried out in the case of M. S., a girl who has just left the Chadwick ward ; in this instance, however, the case was still more unpromising because the patient was older and the knee-joint was the seat of the disease ; but I have every reason to be satisfied with the result. The girl has got a good and useful limb, although the leg had been condemned to amputation in a consultation held soon after she came under our treatment.

My object in these cases has been to relieve the tension of the joints, and by means of drains passed through the ends of the diseased bones to draw off the accumulation of serous fluids and the products of the disintegrated tissues, and thus to allow the blood to resume its passage through the diseased parts of the bone, and by acting on the remaining healthy cells contained in the medulla, enable them to build up new and more stable tissues in place of those which had been destroyed by the unhealthy cell action. To the mind's eye the system adopted somewhat resembles that of draining swampy land and clearing away the underwood in a close damp plantation, so as to give freedom of action to the vegetation we desire to cultivate.

Even in still less hopeful cases than those I have referred to, limbs and joints may be preserved by means of efficient drainage, rest to the affected part, and good air, plenty of fresh milk and wholesome food ; extensive sinuses leading down to dead bone will, under these circumstances, often heal up. But I need hardly remark that cases of this kind require great patience on the part of both patient and surgeon in their treatment; the prognosis depends much on the joint affected, and still more on the general condition of the patient. A continued abnormal rise of temperature and pulse at night must always excite our suspicion, leading us rather to suspect that some of the other structures of the body, beyond the bones, are implicated; for the thermometer, unless in advanced stages of tuberculous disease of the bones, is of little assistance to us in forming our prognosis.

This fact is illustrated in the case of J. M., æt. eight years, in Luke ward. Mr. Butler, one of my most zealous dressers, kept careful records of this instructive case; the little patient had well-marked symptoms of disease of the right hip-joint, the pain being almost entirely referred to the region of distribution of the obturator nerve over and about the knee; he was kept in bed, and extension applied to the limb, but for several weeks there was a constant high temperature, increasing at night. I frequently directed your attention to the patient as we went round the wards. Dr. Allchin examined the boy's lungs, but discovered no evidence of tubercle in them; the optic disc did not indicate neuritis, and so matters went on until suddenly tubercular meningitis declared itself, and the patient subsequently died in convulsions.

The pia mater, lungs, and mesentery were in places covered with miliary tubercle. The acetabulum was perforated, and a mass of caseous material was found under the pelvic fascia, and in the synovial membrane. There was no pus in or about the joint. The cancellated tissue of the head of the femur was full of a cell growth which it was impossible to distinguish from that existing in the pia mater or lungs.

I would urge you to keep in mind the rule that a high temperature in cases of hip-joint disease, or in fact of any tubercular affection of the bones, should always be looked upon with suspicion; depend on it, in the majority of these cases there is danger—often fatal mischief going on in other tissues beyond those of the bone.

And let me here caution you as to how you proceed in your examination of cases of hip-joint disease; for supposing, as in this case, the acetabulum is principally involved, if you exercise an undue amount of pressure against it, especially when the limb is rotated outwards, you may drive the head of the bone into the pelvis, and no doubt shortening of a limb is sometimes produced in this way, but this is even a small evil compared with the mischief that may be caused by roughly handling a limb under circumstances such as I have referred to.

It is well, therefore, to be very gentle in your manipulation of these diseased bones or joints. I have before remarked, that there can be no harm in allowing patients suffering from the commencement of tuberculous disease of the bones to move about, provided they experience no increase of pain in doing so. But it is quite a different thing when movements of the joint or limb aggravate the symptoms from which the patient is suffering; we have, then, good reason for supposing that the whole of the cancellated tissue of the end of the affected bone and the neighbouring joint is implicated, and we cannot therefore be too careful in exercising pressure on the diseased structures. Should it seem desirable to ascertain if crepitation takes place between the ends of denuded bones affected with tuberculous inflammation, it is well to put the patient under the influence of an anæsthetic, so as to relieve the tension of the muscles, and prevent their reflex action.

My own impression is that the longer we deal with cases of advanced tuberculous disease of the bones, the clearer we appreciate the importance of time and general hygienic conditions as affecting their issue. Nevertheless I think, when we have made up our mind that we have done all in our power to improve the condition of the patient, but that the disease is gaining ground, the class of cases we are considering is unfavourable (if the patient be an adult) for the practice of conservative surgery. I need hardly remark, if only one of the bones of the foot appears to be involved, that we are bound to take away so much of the bone as has become rotten before sacrificing the limb; but, on the other hand, if several of the bones are implicated, and the disease of long standing, I believe a Syme's amputation should be at once performed, and I should not attempt—other treatment having failed—to remove the diseased bones, or the anterior part of the foot, by a Chopart's amputation.

There is, however, a most important qualifying circumstance with reference to this remark, and that is regarding the age of the patient. In children you may take away several of the bones of the foot, for instance, and yet it is wonderful what excellent recoveries they make, so that we are unquestionably bound never to sacrifice any portion of a limb we can possibly save among young patients.

In the same way in children we do not hesitate, when necessary, to excise the articular surfaces of the bones entering into the formation of the ankle-joint, whereas with the same amount of disease in an adult I should recommend an amputation below, or at the knee-joint. We have examples illustrating the truth of this doctrine in the wards at the present time. I described to you the condition of the bone in the case of A. W., the lower end of the tibia being occupied by a cavity together with tuberculous deposits, some calcified, and others undergoing cheesy degeneration. In this instance, as the young woman was strong, and apparently healthy, I amputated the leg at its lower third, but above what seemed to be the seat of disease. The stump is a remarkably good one, but the disease of the bone has reappeared. She now (nine months after the operation) complains of gnawing pain in the stump, which increases at night, and she is as convinced as I am that we shall find the end of the bone the seat of fresh disease. It would evidently have been better had I amputated at the knee-joint in the first instance.

My experience so far, is decidedly opposed to excisions of either the knee or hip-joint as a rule, in cases of tuberculous disease, whatever the age of the patient may be.

On the other hand, Agnes B., aged nine, in the same ward, is an example of what may be done in the case of children. I have removed the whole of the first and second metatarsal bones, leaving the epiphysis and as much of the periosteum as was healthy; and the patient has made an excellent recovery, having a very good foot, which will improve as she grows older.

The case becomes more serious when the bones entering into the knee-joint are involved; but even here, in the instance of children, we may gain admirable results by means of careful treatment when the active symptoms of disease have subsided, leaving perhaps a partial displacement of the tibia backwards and fibrous anchylosis, the leg being bent on the thigh at an obtuse angle. We may often, by dividing one or more of the tendons of the hamstring muscle subcutaneously and then breaking down bands of contracted fascia, straighten the leg and keep it in this position until the parts have formed new attachments for themselves.

I mention these cases specially because we have three such little patients now in the hospital, and you can examine them for yourselves, by comparing these casts, made before the operation above referred to, with the present condition of the limbs, and thus convince yourselves how much may be done without incurring the dangers immediately following excision of the joint, or the risk, after an operation of the kind, of the limb remaining dwarfed in consequence of the removal of the epiphysis of the lower end of the femur and upper part of the tibia. In one of these cases (S. B., aged seven), there is still an open sinus leading to soft bone in the head of the tibia ; but since the child has regained the use of her limb she has so much improved in health that I entertain a good hope she will ultimately overcome the tuberculous disease going on in the bone. It is not my intention, however, to enter upon a special account of the treatment to be followed in any particular class of case affected by tuberculous disease, but rather to consider the subject of diseases of the bones in general.

LECTURE VII.

SYPHILITIC DISEASE OF BONE.

Gentlemen,—The notes of the following case have been kept for me by Mr. G. Shaw, and from them we may study some of the leading features of disease of the bones depending upon hereditary syphilis.

M. C., aged eighteen, has resided all her life in London, and, so far as she can remember, enjoyed good health up to the present time. She has in a marked degree the characteristic features of inherited syphilitic teeth; the bridge of her nose is broad and sunken; her forehead is large and protuberant over the frontal eminences; her skin of a dusky hue. Her intellectual powers are imperfectly developed; she does not know her letters, and is childlike in her manner. She has clearly-defined mitral disease of the heart. Through information received from a cousin, it is certain that M. C.'s father was suffering from the effects of syphilis before his marriage; her mother is still alive, but has only had one living child. The patient has been employed as a maid of all work in a small lodging-house; as a rule she has laboured hard for some sixteen hours every day, and has been indifferently fed.

Twelve months ago M. C. noticed what she describes as a small swelling on the lower and outer side of her left leg, just above the ankle-joint. She cannot remember having received an injury to the part, and for some time she took but little notice of it; the swelling, however, increased, and gradually assumed its present dimensions, causing her considerable pain, especially towards evening. About three months since she became quite lame from the above-mentioned cause, and applied for relief as an out-patient. She was ordered increasing doses of iodide of potassium; but as it was evident she required rest and food as well as medicine, she was taken into the hospital on the 14th of June. There was then a clearly-defined enlargement of the lower end of the shaft of the left tibia and fibula, extending round the entire circumference of the bones for about an inch and a half above the ankle. The swelling was most prominent a little above the joint, the skin and soft tissue over the part were natural in appearance, although indurated. The ankle-joint was unaffected. There was no enlargement of any other bone in the body. On admission, the patient was much out of health; the pain in the affected limb was constant, and increased towards night; it was greatly aggravated by pressure applied over it. She was ordered to remain in bed; a properly adjusted splint was fixed to the leg and foot, so as, without pressure on the enlarged bones, to keep the parts absolutely at rest ; the patient was put on full diet, and the iodide of potassium together with iron and quinine were administered.

It would be superfluous labour to attempt to follow out the details of this case. Suffice it to say that the patient was more or less constantly under our care until March, 1877. During this time she was sent into the country. Iodine having failed, she was put on a course of mercury ; the actual cautery was used, Scott's dressing, and, in fact, everything we could think of, employed ; still the enlargement of the bone remained, and the pain continued in spite of all we could do to relieve it ; but I was unable to detect any disease of the ankle-joint.

On leaving London for a time in February, M. C. passed under the care of one of my colleagues ; and on the 27th March, finding effusion had occurred into the ankle, he inserted a full-sized drainage tube through the joint.

On my resuming charge of the wards on the 12th April the patient was suffering from high fever, rigors, dry tongue, a jaundiced skin, frequent purging, and profuse sweats—in fact, from pyæmia. The drainage tube was removed, but there was a considerable discharge of matter from the wound. She continued to grow worse, and so it was determined to amputate the limb some three inches above the ankle-joint. The operation was accordingly performed on the 18th April, and from that time the patient recovered, and left the hospital before the end of May with a very good stump.

In this case we had evidence that our patient's father had syphilis before the birth of his child; the condition of her incisor teeth, the expanded and sunken bridge of her nose, peculiar forehead, and imperfectly developed intellect, all pointed with unmistakable clearness to the fact of her having inherited the disease from which her father suffered. Doubtless, as an infant, she had had inflammation of the Schneiderian membrane, and probably blotchy and scaly rashes together with other symptoms of syphilis; but these had passed away, and, as is common in instances of the kind, the child grew up to be a robust woman, and then the disease of the bone appeared.

Referring to a case we have lately seen, I shall on another occasion explain to you the circumstances of certain lesions that occur about the epiphyses of the bones of newly-born syphilitic infants.

But the affection we are now considering is most frequently met with in the children of syphilitic parents, as a rule, from their fifteenth to their thirtieth year. It usually commences as a slowly increasing enlargement of the ends of one or more of the long bones, including the phalanges of the hands and feet, but it may appear in the vertebræ, pelvis, or flat bones. The pain in the affected part is generally intermittent, increasing towards night. When in bed, starting of the affected limb is not an uncommon symptom. Neighbouring joints are seldom implicated, unless in an advanced stage of the disease; its characteristic features being gradually increasing swelling of one or more of the long bones, uncomplicated with joint affections or necrosis of bone.

These syphilitic affections of bone are not unfrequently met with about the upper end of the femur; but there, as in other localities, those parts of the bone which are not covered with periosteum remain free from disease; and so, although there may be considerable thickening of the femur about the trochanters, the head and neck of the bone remain healthy. The same fact is demonstrated when the disease involves the extremities of the humerus, or the bones near the knee and ankle joints, for those parts covered by synovial membrane, or articular cartilage, are never primarily implicated in the abnormal growth or disease which we are now considering.

This remark applies to cartilage as well as bone. It is only when this structure is covered by perichondrium (a modified form of periosteum), such as we find in the cartilage composing the larynx, that syphilitic affections of this structure are met with. This fact, which is drawn from the clinical study of many instances of the kind, leads to the conclusion that in the majority of these cases of syphilitic disease, if not in all of them, the abnormal action commences in the periosteum surrounding the extremities of the affected bones, and that the actual disease of the bone which sometimes occurs is secondary to the affection of the periosteum.

The course which most of these cases run, points also to this conclusion, because the slowly enlarging painful extremity of the affected bone is unquestionably amenable to the influence of mercury. Under a judiciously administered course of this drug, the disease gradually disappears, although it may have existed for months. But I know of no abnormal condition of the true osseous structure, or rather, I should say, medullary tissue, leading to enlargement of the bone, which is beneficially influenced by mercury or any other drug. Nor do I think it possible, from the minute anatomy of the parts, that such would be the case. We cannot imagine a syphilitic or any other form of inflammation which could run its course unchecked for a considerable time in the medullary structure of a bone, and then give way to treatment; for during the course of any such persistent action in this delicate structure, sclerosis or other changes in the bone would have occurred, from which the parts could hardly recover or regain their healthy functions after a few weeks' treatment, as many instances of long-continued syphilitic disease certainly do.

I may go a step further and observe that doubts exist in my mind as to the accuracy of the description frequently given regarding portions of diseased bone having "expanded" in consequence of inflammatory changes occurring in the cancellated tissue (ostitis); such a change may take place, but the more carefully we examine specimens of the kind, the clearer it becomes that in the majority of them, the enlargement of the bone is due to layers of periosteal new growth, superimposed one over the other, so as to produce a greater or less increase in the size of the bone.

But the question naturally arises, how was it that an amputation became necessary in a case of this kind? For if there is one fact more certain than another regarding these syphilitic cases, it is, that a mild mercurial course, and, above all, time and patience, will cure the disease.

In reply to this question, in the instance of M. C., it was necessary to remove the rotting parts from which her system was being infected, in order to save her life. No doubt the access of the impure air of our hospital wards passing into the joint through the unprotected drainage-tube, had set up dangerous putrefactive changes in the tissues, which had then been absorbed into the system, and produced the diarrhœa and other symptoms of septic poisoning from which our patient was suffering before the operation.

The pyæmia was the immediate result of an injury, and not of the syphilitic disease; had the latter run its natural course it is probable, before an opening into the joint through the skin had occurred, that sclerosis of the extremities of the bone entering into the articulation would have formed a barrier to the absorption of matter from the medulla into the general circulation.

I was averse to an excision of the joint in this case because, as a rule, among adults, instances of excision of the ankle-joint, except in traumatic cases, do not make good recoveries, and the existence of pyæmia quite forbade such an operation. Then, again, this patient being infected by inherited syphilis was a bad subject for a complicated operation of the kind. Syphilitic patients are unfavourable persons to operate on. And, lastly, the disease of the heart from which M. C. suffered was of such a nature as to lead Mr. Beer, our chloroformist, to demur to giving anæsthetics, and to urge me to complete my operation as speedily as possible, so that our patient should not be under the influence of ether longer than was absolutely necessary.

These considerations, and the fact that I was not sure if I could remove the entire disease by excising the joint, induced me to amputate the leg at its lower third.

Before the operation, we might well have been under the impression, that the patient was suffering from enlargement of the lower cancellated extremity of the bones of the leg, for there was evidently an increase in the size of the bones in this situation, which was marked on comparing the left with the right leg, In the records of the case the expressions the "enlargement," and "swollen" end of the tibia and fibula, recur over and over again, and had the case terminated favourably, we might perhaps have supposed we had cured an instance of "inherited syphilitic ostitis." But you now see how false our conclusion would have been, for on examining the diseased ends of these bones we find that their enlargement is not due to ostitis, but to the growth of a uniform layer of new bone outside the tela ossia of the original bones, that is, outside the layer of compact bone which was originally formed round the lower epiphyses. A sheath of bone has here grown from the periosteum, like the provisional callus round the site of a fractured bone in one of the lower animals, and we have an enlargement of the lower inch and a half of the tibia and fibula, not from changes occurring in its cancellated tissue, but from a periosteal growth. This is, as I have before remarked, one of the features of syphilitic affections of the extremities of the long bones, whether inherited or otherwise, which distinguishes them from tuberculous disease of bone, which originates in alterations in the growth of the round cells contained in the medullary tissue.

We noticed that in cases of uncomplicated tuberculous disease of bone the indications afforded us by the thermometer are hardly to be relied on. Howdifferent is this in syphilitic affections! If we examine M. C.'s temperature chart, we find that week after week the mercury in the thermometer showed that at night the temperature of her body invariably rose to 101° or 102°, and fell to 99° towards morning. Iodide of potassium did not influence this abnormal temperature, but twelve grains of quinine, with the eighth of a grain of extract of Calabar bean, invariably checked the rise of temperature for some days after it was administered.

Doubtless, as this growth of new bone surrounding the end of the tibia increased in density and thickness, the bloodvessels passing through it into the cancellated tissue would have been pressed upon and injured, and the nutrition of the medulla would have suffered, and in time might have been so defective that necrosis of the bone would have occurred, but not inflammation; and we might then have found the lower portion of the tibia dead and surrounded by new bone produced, as abovementioned, from the periosteum. We see indications of the commencement of this process in sclerosis of the tela ossia within this periosteal growth; and also in this crescentic patch of necrosis which you observe at the lower end of the tibia, and which is remarkable as demonstrating in the osseous system the existence of the law which so often governs the extension of syphilitic ulceration of the soft parts, and which causes them to spread in a circular form.

In this case the contents of the cancellated tissue of the astragalus are not only perfectly healthy, so far as we can ascertain by the microscope, but its condition affords us a good illustration of the way in which new bone is formed from the medulla after an injury, showing that the normal functions as well as the structure of this delicate tissue have been unaffected to any great extent by the disease progressing in the tibia and fibula.

On making sections through the astragalus we find its articular cartilage and the subcartilaginous layer of bone have entirely disappeared, their place being occupied by granulation-tissue which is supplied with vessels continuous with those in the cancellated tissue of the bone; beneath this soft layer of granulation-tissue there is a broad stratum or layer of newly formed bone. The round cells of the medulla filling the original spaces in the cancellated tissue of the bone have become surrounded by an homogeneous material, and are embedding themselves in a deposit of bone-earth. Had calcification progressed in this layer, we should have found a stratum of dense bare bone projecting into the joint; as sclerosis advanced into this layer, the vessels supplying the granulation-tissue on the articular surface of the bone would evidently have been cut off, and so this soft vascular structure would have perished, leaving the newly-formed and denuded hard layer of bone beneath it. This layer of bone having once formed in the manner I have described from the cells contained in the cancellated tissue, would not only have effectually prevented the absorption of matter from the joint through the medulla into the blood, but also have prevented the bone-producing elements contained in the proximal ends of the tibia and astragalus uniting, or becoming anchylosed.

In this specimen I think the direction taken by the newly produced layer of bone, or that parallel to the joint, leads to the conclusion that it had been formed in consequence of the changes induced by the atmosphere and drainage-tube introduced into the part; and this idea is strengthened by the fact that, with the exception of the newly produced layer of bone immediately beneath the original articular surface of the astragalus, the medulla throughout the astragalus was healthy. I mean, that if this layer of newly formed bone had resulted from constitutional causes, it is hardly probable that the abnormal action would only have manifested itself in the formation of a layer of bone such as I have described; whereas supposing it to have resulted from injury of the part, we have a cause sufficient to account for the pathological changes noticed in this specimen.

Part of this new subcartilaginous bone has become thoroughly organised, but the larger portion of it contains a number of the round cells, which are being imbedded in bone-earth, or, in other words, are undergoing transformation into lacunæ; after a time most of these cells would disappear. It seems to me that when we read of inflamed bone possessing numerous lacunæ produced by the proliferation of the bone corpuscles, it is, in fact, nothing more than a thin layer of the medullary structure in a stage of transformation into bone such as I have described; for it is hardly likely that the cells of the original bone corpuscles can increase and multiply to any great extent after ossification has once been completed around them.

From the condition of the parts in this specimen we can also comprehend how it is that our treatment did not succeed in arresting the progress of the disease, for we find the layer of bone formed under the periosteum consists of hard, fully organised, osseous trabeculæ. Had the case come under our treatment in its early stages, or before ossification had been completed, it is more than probable that either iodide of potassium or mercury would have effected its removal; but under existing circumstances our drugs had no more influence over the growth than they would have had in causing the absorption of an exostosis, and this demonstrates to us the importance of treatment in the early stages of syphilitic affections of bone. The same remark applies to ordinary cases of syphilitic nodes; in fact, the ring of bone formed in this case is a node surrounding the lower end of the tibia and fibula.

The reason why these periosteal growths appear mostly about the extremities of the long bones in cases of inherited syphilis is probably, because in the growing bone the most active changes are going on in this locality, and, as I have before remarked, we see precisely analogous formations round the seat of ill-set fractures, increased action in both cases determining an augmented growth in the part.

The sheath of new bone, therefore, surrounding the lower part of this tibia and fibula has been produced from cells contained in the periosteum which, as I have frequently mentioned before, is a form of fibro-cartilage, its minute anatomy being modified by vessels and so on. But the inherent tendencies of its round cells (osteo-blasts) are under all circumstances the same as those of the medulla, and so we see in this sheath of newly formed bone that from its deep surface, corresponding to the line of growing bone in cartilage, earthy matter is being secreted by the round cells, and thus the hard osseous material of the new bone is produced, Some of the round cells subsequently form lacunæ or bone-corpuscles, the spaces between the lines of ossification becoming filled with vessels and medullary tissue, or, if ossification continues among the contents of these spaces, the medulla is converted into bone surrounding central vessels, and an Haversian area is produced in the new bone.

It by no means always happens that periosteal growths, such as we see in the case of M. C., encircle a bone ; they may assume a variety of forms, sometimes appearing as a ridge, at other times as a nodule of new bone ; but the idea I wish particularly to force on your attention is that it does not follow because a syphilitic patient complains of continuous deep-seated pain in the extremities of one or more of the long bones, with a uniformly hard and swollen condition of the bone, that the part is necessarily the seat of ostitis, involving the structures contained in the cancellated tissues of the bone; on the other hand, in most instances of this affection the diseased action is primarily confined to the periosteum, the shaft of the bone being implicated in consequence of the abnormal changes occurring in the outer covering of the bone.

The phalanges of the hands and feet are sometimes affected in a marked manner by "dactylitis syphilitica," or, in other words, by periosteal formations such as I have described surrounding the extremities of these bones. I have seen several cases of this kind. Surgeon S. Deakin, of the Bengal medical service, lately reported an instance of this form of disease in the Indian Medical Gazette :—

"K. B., aged 35, came under treatment on 11th October, 1877.

"Previous history states that he had syphilis eight years ago, never since; he then had two chancres which, he states, were not followed by any skin eruption, sore throat, nor loss of hair.

"*Present state.*—Body rather thin, though his general health is fair.

"He came to hospital for a swelling on his right hand, which had existed for six months. This involved the palmar, and to a less degree the outer surfaces of the thumb, chiefly over the 'metacarpal' bone and extending over the joint to the metacarpal phalanx. The skin over the part was a deep reddish black colour, the blood showing through the pigment of the skin, and was stretched tightly; it had a glistening appearance; there was very little pain on pressure. At the top of the swelling the skin had sloughed, and there was a small ulcer, the size of a four-anna piece, from which exuded a little curdy pus mixed with clear serum.

"Over styloid process of left radius, on the anterior surface a node had formed; this is tender on pressure and rather soft. Another soft node exists above and behind the internal condyle of left humerus.

"On the left tibia there is a large node at the upper part of the shaft, extending to the head of the bone; this is also tender on pressure, and is, at night time, subject to severe attacks of neuralgia, as is also the left claviculo-scapular joint."

We have not, however, finished with M. C.'s tibia. You will observe, on making a longitudinal section of the bone, that near the articular surface the cancellated tissue is occupied by a white cloudy material, very like that noticed in the cornea of persons suffering from interstitial keratitis, or the neoplastic formation observed in syphilitic retino-choroiditis.

When examined under the microscope, we find that the cancelli of the bone in the zone of cloudy material is occupied by ill-defined, soft-looking, nucleated cells, surrounded by fatty molecular matter. This material seems to be infiltrated among the normal elements of the medulla, and then to have spread in a circular form, after the fashion of the fairy ring which we frequently see on the grass of our meadows, and, like the fairy ring, the neoplastic formation we observe here has a tendency to disappear from one spot and appear in another. Nevertheless, with its disposition to wander from one spot to another, it has a persistent, I might almost say tenacious hold on the area infected by it. Month after month, and year after year, it is apt to recur in the neighbourhood first invaded, probably because it there meets with a fit soil in which to grow.

I wish to draw your special attention to the fact, that the area of increased vascularity is a consequence of, and not the cause of, the necrosis of this small piece of bone; and this is the rule in most cases of ostitis. The deep injection of the bones seen in instances of this kind is seldom uniform, but is rather found passing as broad crimson bands through the cancellated tissue, enclosing patches of comparatively bloodless structures in which, and not in the vascular area, we find the greatest alterations in the elementary tissues of the part. In some cases these changes arise from an increased growth of the round cells choking up the blood channels; in others a fibroid material such as we see here appears to induce a similar result; but in all these instances of syphilitic disease, extensive, and probably painless imperceptible changes had taken place in the living tissues before the stage of vascular engorgement or increased collateral circulation, attended by the characteristic symptoms of inflammation, declared themselves, and these primary changes, unless carefully attended to, or if excessive in their action, result in suppuration. But we should attempt, under all such circumstances, to realize the fact that local inflammation is the sequel of pre-existing alterations in the structures among which it occurs, and upon these we must endeavour to exercise our curative powers.

As a rule, the neoplastic syphilitic formation which occurs in the cancellated tissue of bone, on account of its shifting disposition, excites only transient hyperæmia in any one spot of the surrounding medulla. But the neoplastic formation sometimes appears to be stationary, and, by its presence, disturbs the nutrition of the structures among which it forms, and so becomes surrounded by a zone of congested vessels. These vessels run up to the border of the cloudy neoplasm, but they do not enter the new formation, and so a stationary zone of congested vessels encircles the neoplasm. In consequence of this vascularity of the part sclèrosis of the trabeculæ contained in the congested zone takes place, and, further, the round cells of the medulla proceed to manufacture new bone, as I described to you in the case of the articular surface of this astragalus; and thus the syphilitic neoplasm becomes enclosed in a layer of dense new bone, which necessarily limits the blood-supply passing into the affected area, and consequently death or necrosis of the bone occupied by the cloudy syphilitic neoplasm occurs, without suppuration.

Nor is it likely that new bone would replace that which dies, because the bone-producing elements of the medulla are, like the vessels, prevented from occupying the cavity left by the necrosed bone, being excluded from it by the layer of new and sclerosed osseous tissue formed in the manner mentioned above.

The account I have given you of the pathological changes noticed in this specimen is the history of almost all instances of syphilitic ulceration and necrosis of bone, in whatever stage of the malady the bones are affected. Cases of the kind are commonly met with, involving the bones of the skull, the abnormal action commencing beneath the pericranium, or it may be in the diploe, and often only terminating in the removal of a portion of the skull, the cavity which is left remaining as a depression in the bone, surrounded by thickened and hard walls. But cases of syphilitic affections of the bone beginning in the medulla are rare, compared with instances of disease originating in the periosteum or external soft parts, and compromising the bone by cutting off its supply of blood which naturally passes to it through the periosteum.

Syphilitic affections are less frequently met with in the medulla than in the periosteum in proportion to the small quantity of connective tissue contained in the former structure as compared with the latter; and as evidence of this—with the exception of the woolly appearance presented by the contents of the cancellated tissue above noticed, which might be comprised in a spot equal to the circumference of a shilling—the whole of the medulla in the lower ends of this tibia and fibula is healthy, the diseased action has been confined to the abnormal growth of bone from the periosteum; there the perverted action doubtless commenced by the appearance of a soft, opaque syphilitic new formation, and this, altering the nutritive changes of the part, induced hyperæmia, and consequently increased osseous formation from the round cells contained in the part. But this light woolly neoplasm represents to our minds the fact clinical experience teaches us, which is, that in the early stages of syphilitic disease the abnormal action might be overcome by appropriate treatment.

We have hardly sufficient evidence to support the idea that the adenoid tissues or the round cells of the medulla take a direct share in the initiative stage of syphilitic disease, and in this respect syphilis differs, I think, from tuberculous affections. Then, again, in syphilis the tendency is to the formation of new periosteal bone, or else to necrosis without suppuration or joint complications, whereas tuberculous disease frequently runs on into suppuration, the molecular disintegration of the part affected involving neighbouring joints. Unfortunately we know of no specific for tuberculous affection of the osseous system; the greater number of syphilitic diseases of the bone are cured, if taken in time, by a judicious course of mercury and iodide of potassium. I think the combination of bichloride of mercury (the one-twelfth of a grain) with ten grains of iodide of potassium, taken three times a day, is a convenient form for exhibiting these drugs; but if the case is a bad one, small doses of Pil. Hydg. and opium should be given until the characteristic effects of the mercury on the system manifest themselves; subsequently the Hydg. Bichld. and iodide of potassium with cinchona may be continued for some months. No treatment short of this will be of any permanent advantage to the patient.

The preceding remarks refer to instances of inherited syphilitic disease of the bones occurring among young persons from about the age of fifteen to thirty, but we occasionally meet with cases of abnormal changes in the bones which manifest themselves soon after birth. The following is a case in point.

J. W., aged two months, was sent with her mother into the Chadwick ward last October. The child since her birth had suffered from snuffles, and patches of roseola on her chest and back. She had eczema of the genital and anal regions, arising from the irritation produced by condylomata. We found that the bones of this child's fore-arms were enlarged above the wrist-joints; there were symmetrical nodular projections of bone above the olecranon processes, and similar excrescences were found on the outer condyles of the femurs (these were about the size of a split horse-bean); there was enlargement of the bone over the greater trochanter of the right femur, and on the same side the lower end of the tibia and fibula were swollen just above the ankle-joint.

The child's mother was in good health; she had been married four years, and during that time had had a miscarriage; this was her first living child. Her husband had complained of pain in his bones, and had ulcers, as his wife called them, on his chest and legs. As the patient's parents were in good circumstances, I only kept the child in the hospital for a week, to demonstrate to you that in the case of a young infant labouring under syphilis, a constant rise in the temperature occurs every evening. The patient was subsequently ordered to be brought as an out-patient, and directed to take five drops of the following mixture twice a day, in water:—Half a grain of bichloride of mercury, two drachms of iodide of potassium, and two ounces of water.

This treatment was continued for a month, when it was evident not only that the child had improved in health, but there was a diminution in the size of the swollen bones. I then ordered the medicine to be given three times a day; it was subsequently gradually diminished in quantity. At present (six months after first seeing the child) she has lost all symptoms of syphilitic disease, and, although puny, is apparently thriving and in good health.

This is a typical instance of the course which this form of disease runs, provided it is brought under treatment in its early stages, and the child is well fed and cared for; but if the disease is neglected and the patient badly nourished, degenerative changes are apt to occur about the affected part, so that the epiphysis of the bone becomes separated from the diaphysis, and joint complications may supervene, ending in anchylosis of the joint, or even the death of the patient.

In early life the growth of the long bones is necessarily rapid. They consist of a shaft or diaphysis, and of certain smaller portions situated at each end of the shaft, but separated from it by an intermediate layer of cartilage; these are the epiphyses. The increase in the length of the bone is principally due to the growth of new bone, which occurs at the line of junction between the ends of the diaphysis and the adjacent cartilage. In this particular locality, therefore, the nutritive changes are more active than in any other portion of the bone, and it is precisely at this spot that marked degenerative alterations occur in infants suffering from syphilitic disease of the bones.

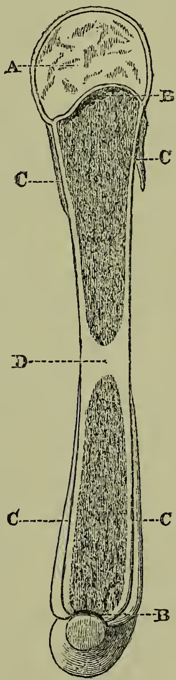

FIG. 3.—Section of humerus in case of inherited syphilitic disease of bone in an infant.

A, Head of humerus (epiphysis).

B B, Diseased tissue separating the diaphysis from the epiphysis.

C C C C, Thickened sheath of periosteum surrounding the ends of the diaphysis.

But in instances of the kind, the abnormal action is, I think, hardly confined to the ends of the diaphysis, for we meet with nodular swellings of the bones such as I have described; and, in addition, cases of the kind sometimes present circumscribed swellings over the frontal bones; and in most specimens, where there has been separation of the epiphysis from the diaphysis, the periosteum surrounding the affected part is more or less seriously implicated (see Fig. 3). So that it appears from the clinical history and pathological changes observed in these cases that the diseased action is marked at the extremities of the long bones, where nutritive changes are the most active; it is not, however, confined to the ends of the long bones, and does not manifest itself in the interior of those parts of the extremities of the bones which are not covered externally by the periosteum: the upper part and trochanters of the femur, for instance, may be involved in the diseased action, but the head and neck of the bone remain healthy.

These facts seem to point to the conclusion we have arrived at with reference to the action of either acquired or inherited syphilis on the bones of adults, which is, that in the majority of cases the periosteum is the tissue primarily involved in the diseased action, the bone being implicated in consequence of the periosteal abnormalities.

One of the best specimens of this form of disease I have seen was lately exhibited by Mr. Warrington Haward of St. George's Hospital, at the Pathological Society. The changes occurring in the end of the diaphysis are well marked, the bone in this situation being separated from the cartilage ; but I think there is abnormal ossification of the periosteum ; a case of new bone having formed round some of the diseased epiphyses, very like that which we had seen enclosing the lower end of the tibia and fibula in the instances of M. C. And, knowing as we do that the vessels supplying the extremities of the rapidly-growing bones of infants pass through the periosteum, it follows that, if this latter structure is diseased, the supply of blood, in fact the nutrition of the epiphysis, must be compromised ; and so it is probable, as in this case, degenerative changes have occurred at the extremity of the diaphysis.

Dr. R. W. Taylor, of New York, has lately published a valuable treatise " On Syphilitic Lesions of the Osseous System in Infants and Young Children." He gives the records of a considerable number of cases treated by himself and others, in some of which the separation of the epiphysis from the diaphysis was marked during life, and the lower part of the bone could readily be moved in the antero-posterior or lateral direction, independently of the movements of the joint. Crepitation was sometimes felt between the ends of the bone, but even in cases of this kind the parts may regain their normal functions, and the limb ultimately become a useful one.

Instances of this kind are rare, in which enlargements of the bones such as I have noted are the only symptoms of infantile syphilis, for the characteristic feature of this affection is, that it is accompanied with other well marked syphilitic lesions; and it is hardly possible to mistake these, for symptoms of rickets or any other form of infantile bone disease. Moreover, rickets is preceded by well recognised symptoms, and seldom manifests itself until the patient is some six months old, when the soft patches felt over the occiput and the symmetrically enlarged extremities of the ribs are characteristic of the disease.

A case of the kind might possibly be complicated with syphilis, but even in an instance of this description the coryza, eruptions, and mucous patches will indicate clearly the nature of the affection.

Dr. Taylor believes that syphilitic epiphyseal affections may be confined to the phalanges and other bones of the hands and feet, but, in the absence of other evidence as to the existence of inherited syphilis, we might safely consider that instances of disease of the bones of this kind are generally due to non-specific epiphysitis (see p. 45).

In conclusion: however young the infant may be, having diagnosed the affection from which he suffers to be of syphilitic origin, we cannot commence a mercurial course of treatment too soon. Mercury combined with iodide of potassium are the drugs and the only means upon which we can safely depend for the cure of these cases.

Gentlemen,—I have thus far kept myself almost clear of expressions regarding the nature of syphilis, and the probable reasons why we find it attacks the periosteum rather than the medulla of bone; if, however, you have feelings similar to those I possessed as a student, you will not object to a certain amount of speculation on these matters, and there can be no harm in our indulging in theories so long as we distinctly and clearly recognise the nature of the ground upon which we are treading.

It is commonly held that syphilis is a blood disease, by which we mean that every particle helping to form one side of the body has its counterpart in an identically similar particle on the other side of the body, and that any deleterious agent in the blood, whether chemical or otherwise, will affect these particles in the same way, and hence the phenomena of symmetrical disease. I do not deny the ingenuity of this theory, at the same time the premises on which it is based are absolutely incapable of verification, and moreover, with reference to the action of chemical agents, when poisons of this nature are admitted into the circulating fluid they do not increase in the body, and they affect the system within twelve hours of the time they pass into the blood, so that they differ in their mode of action on the body in the most palpable and manifest manner from that of an organic infective matter such as syphilis.

The course which syphilis runs points rather to the idea of its depending upon the grafting of a specific matter into the living connective tissue cells; the germs of syphilis having thus been introduced into the soil, take root and spread along the course of the lymphatic system, the radicles of which originate in the connective tissue, and so the disease wanders through its appropriate soil, altering as it extends the elements contained in the compound parts of the lymphatic system in a manner which is at present a mystery to us, but which is demonstrated by its action changing the nature of the body once attacked by this disease. It may be that it uses up something necessary to the growth of syphilitic germs, so that when the disease has passed through the system—that is, after the first fortnight or three weeks when the syphilitic fever is present—it has exhausted the tissues of the materials necessary to its primary manifestation. All that subsequently follows is due to the permanent hold the original disease takes upon definite structures, but which are referable from first to last to changes in the nutrition of the connective tissue; or to make the matter more intelligible to the mind's eye, syphilis attacks the structures which are coloured brown by nitrate of silver solutions in the method employed for staining the tissues. I readily grant that the outcome of the changes differ somewhat as they affect the skin, mucous membrane, and so on, air, light, moisture, and other circumstances, both without and within the body, influencing the result; but it is the self-same organic matter which is at work, as proved by the power the living portions of the affected part have of reproducing the original disease in an unaffected person. Doubtless, the blood passing through diseased areas, may carry away with it particles of syphilitic germs, and so, if inoculated into the circulation of another person, may propagate syphilis.

I look upon syphilis, therefore, as consisting of a specific or definite form of organic matter, which lives and grows in the living connective tissues of the human subject, and in proportion to the amount of this tissue entering into the formation of any given area of the body, so will that part be liable to the ravages of this disease, and consequently the so-called syphilitic ostitis is probably an unimportant, if not a rare form of disease, because the interior of the osseous system is sparingly supplied with connective tissue; the periosteum on the other hand is mainly constituted of elements in which the syphilitic germs rejoice, and so nodes and syphilitic gumma of the outer covering of the bones are of frequent occurrence.

I conceive that the action of mercury in the alleviation of the phenomena produced by syphilis in the body is similar to that which this metal seems to exercise on syphilitic matter taken from a chancre, and exposed to the mercurial fumes. I was engaged some years ago in an attempt to solve the life-history of the organic infecting matter which causes Asiatic cholera, and in connection with the subject it seems to me the circumstances of the contagion of small-pox, and syphilis might throw some light on the subject. I ascertained that the organic infective matter of cholera, like that of syphilis, might be kept in a dried condition for a considerable time without losing its infective properties, but if the matter from an infecting chancre be removed directly from the sore on to a glass slide, and exposed for a short time to the fumes of mercury, it becomes innocuous, and incapable of producing syphilis. And so I believe in the human body, the mercury must be so universally diffused through the system as to be brought into contact with every single particle of the syphilitic virus existing in the body of the person affected by it, and thus arises the necessity for continuing the action of this drug long after the manifest symptoms of the disease have disappeared, because if any of the organic infecting matter escapes direct contact with the mercury, it is capable of multiplying to an indefinite extent, and spreading through the connective tissues. A comparatively small quantity of mercury administered to a patient suffering from syphilis, will reduce the temperature of his body—the increased temperature of the disease being simply the index of the tissue changes occurring in consequence of the action of the organic infecting matter on the tissues; but the arrest of the fever is no proof whatever that the germs of the disease have been destroyed; the probability is that a quantity of living infective matter remains lurking in the soil, unaffected by the destructive influence which mercury unquestionably exercises upon it, until it has been thoroughly subjected to the contact of that mineral.

LECTURE VIII.

CONTUSION, FRACTURE, NECROSIS AND ULCERATION OF BONE.

GENTLEMEN,—Our hospital note-books contain the records of numerous cases of contusion of bone, for hardly a week passes without accidents of this kind being received into our wards. For example—

William H., a labourer, while at work some three weeks ago, was struck by an iron bar across the lower part of his left leg. The soft tissues were bruised. He continued at his work, however, for twelve days after the accident. He was then compelled to rest in consequence of the great pain he suffered in the injured part, and, under these circumstances, he was admitted into the hospital. We found the lower third of the leg slightly swollen. There was no redness of the skin, but he complained of deep-seated pain in the bone, especially when pressure was made over the anterior surface of the tibia. His temperature rose to upwards of 101° at night. A splint was applied to the limb extending beyond his foot, so as to prevent his moving or standing on the injured leg. The limb having been kept at rest for a fortnight, the pain subsided, and the patient left the hospital perfectly cured.

Simple as the details of this case are, they illustrate the fact, that at the time of injury the medullary tissues of the bone were bruised, and, in consequence of this contusion of the parts, the nutrition of the soft structures had become impaired, not only by the bruising of the tissue, but also from effused blood pressing on the vascular sinuses of the medulla and impeding the circulation in the part. The contents of the cancellated tissue of the bone are, under these circumstances, in somewhat the same condition as the brain after concussion, and the period of reaction is one of more or less excitement depending on the amount of injury and the treatment the patient has received. The medulla, like the bruised brain, must have rest in order that it may regain its proper functions, otherwise the reparative process may not only be delayed, but in overcoming the opposition to healthy nutrition in the part, superabundant elements may form, and so suppuration with its consequences are established, leading probably to the death or necrosis of a portion of the bone. On the other hand, if the mechanical injury done to the medulla is not excessive, and the patient is in fair health, with rest, the effused blood in the contused tissues is speedily absorbed, and the parts return to their normal condition.

It is not difficult to satisfy oneself that extravasation of blood does occur into the medulla after an injury to the bone such as I have described, for accidents of this sort are not uncommonly received by persons who have likewise been severely injured in other parts of the body, resulting in the death of the patient. Under these conditions, I have made sections of the bones in the contused limbs and found the cancellated tissue full of extravasated blood, the osseous trabeculæ being incapable of distension, the blood effused into its spaces presses with injurious consequences upon the delicate and torn structures of the medulla. Some of these specimens clearly demonstrate that extravasation of blood from a contusion may take place into the cancellated tissue without there having been any perceptible mischief done to the periosteum.

It seems very probable that in severe concussions of the spine, hæmorrhage may occur into the bodies of the vertebræ leading to disease of the bones. Although the elastic inter-vertebral substances are a protection against such an accident, it is well to bear the fact in mind, because it is possible hæmorrhage taking place into the osseous tissue producing perhaps no marked symptoms at the time, may subsequently set up diseased action in the bones and also of the spinal column. A severe sprain may in this way induce serious disease, as in a case mentioned by Mr. Stanley: "A middle-aged man, whilst holding a ladder which he had raised from the ground, was turned sharply round by a gust of wind. From that instant he felt pain in his back, which continued; and, in the course of the following six months, angular projection of the spinous processes of the middle dorsal vertebræ ensued, with complete loss of motion and sensation in the lower limbs. He gradually sank. On examining the spine, I found the bodies of three of the dorsal vertebræ extensively ulcerated, and a detached piece of the middle of these vertebræ displaced backwards into the spinal canal, and compressing the cord."

The only treatment necessary in the majority of cases of contusion of the bone is rest, so as to allow the bruised tissues to recover from the effects of the injury they have received.

Dr. Sayre, of New York, and not a few other surgeons, hold that hæmorrhage (resulting from concussion) into the cancellated tissue beneath the articular cartilage is the primary cause of most cases of diseased joints among young persons. In describing the tubercular affection of bone, I have given you my reasons for dissenting from these views, that accidents of this description are the most frequent source of morbid action in the joints; in fact, the elastic cartilagenous condition of the extremities of the long bones in children would appear to be an effective safeguard against the jar necessary for the rupture of vessels by contusion in the cancellated structure; but I readily admit that, in the case of heavy falls or injuries, children, like adults, may suffer from bruising of the medulla—

and with them, in consequence of the greater vascularity of the young bone, it is peculiarly necessary to preserve the parts at rest after an injury until the extravasated blood and bruised tissues recover themselves. As I have before remarked, among scrofulous patients, liable to tuberculous changes in the medulla after contusion, the fault consists in a want of power in the cells to recover themselves from the effects of the mechanical injury they have received, and, under these circumstances, instead of properly organised action they produce a weak over-grown structure, the life-history of which I have attempted to describe in my lecture on scrofulous disease of bone (p. 88).

FRACTURE OF BONE.

The process by which fractured bones are re-united has been the subject of numerous treatises, opinions differing remarkably as to the reparative action, because authorities hold adverse views regarding the formation and growth of the osseous tissue, and it is consequently impossible for pathologists to describe changes with precision respecting which they are themselves doubtful.

It is evident that the repair of a fracture is effected by a process identical with that of the formation of bone, because, after a time, it is impossible to discover the site of the injury; the ends of the broken bone having joined by continuity of structure, differing in this respect from what generally occurs after similar injuries to most of the other tissues of the body.

Let us imagine that a person's tibia has been fractured at the lower third, the skin having been uninjured, and suppose the patient, immediately after the accident, is brought into the hospital, and the ends of the broken bone having been carefully adjusted, the limb is secured in splints or a plaster of Paris bandage, and kept absolutely at rest for six weeks. On removing the bandages we find round the site of fracture that a certain amount of new bone has been produced, and that the ends of the broken tibia have united: in another three weeks or a month the patient is able to limp about the wards, and in a short time resumes his work.

Under conditions such as I have described, in the course of a week or ten days after the accident, the blood effused into the periosteum and between the ends of the broken bone is gradually absorbed, and the circulation in the injured tissues restored. We have, therefore, a free supply of blood and an abundance of bone-forming cells in the medulla and periosteum at the site of fracture, ready to commence the process of repair. The injury done to the part at the time of fracture throws the component elements of the periosteum and the medulla into increased activity. We might almost say, in the terms of modern science, that the force necessary to effect the fracture having been communicated to the living cells, has converted their potential into active energy, so that on the re-establishment of the circulation through the injured structure the cells of the periosteum increase rapidly, and forming a hyaline material round themselves, secrete bone earth into their soft covering, and so built up new bone, producing a provisional callus, as it is called. This envelope of osseous structure is firmly attached, in fact is a part of the bone, but it hinders the passage of vessels into the shaft of the bone from the surrounding soft structures, and so impedes the process of repair by the round cells of the medulla ; but as the laws influencing the symmetrical proportion of the body resumed their action, the perverted growth at the point of injury is limited, and ultimately removed. In the meantime the round cells of the medulla have likewise produced an abundance of bone-forming elements; these growing from either end of the broken tibia unite, and the continuity of the fractured bone is re-established. In the course of years it may be impossible to discover the site of the original injury.

As I have repeatedly demonstrated to you, the cancellated structure of the ends of the long bones is largely supplied with blood from vessels passing through the periosteum, anastomosing with branches of the nutrient artery, so that, under ordinary circumstances, if a bone is fractured and the nutrient vessel torn across—a complication which, from my observation, by no means frequently happens even where there is apparently considerable displacement of the fractured ends of the bone—still the lower fragment receives a sufficient supply of blood from the periosteal vessels to keep it alive, and capable of producing new bone. But suppose the fracture happens to be across the lower third of the tibia, midway between the cancellated tissue and the entrance of the nutrient artery into the bone, then the lower fragment at the site of fracture, as demonstrated by Mr. Curling, will receive a deficient supply of blood, if the branches of the nutrient artery have been torn across, and its medulla may be unable to form any new bone, and it will then remain disunited from the upper fragment—in other words, an un-united fracture is the result, and it may be that the lower portion of the tibia becomes somewhat atrophied from insufficient blood supply. Accidents of this description are necessarily more likely to occur among old and weakly subjects than in the case of patients in good health.

The chief cause, however, of non-union of fractured bones is, that the fragments are not brought into exact apposition with one another, and retained there without the slightest movement. I have already referred to this subject when speaking of sclerosis of bone (p. 14), and fracture of the neck of the femur, so that I need not occupy your time by going over the same ground again ; but if union is prevented between the ends of a broken bone, they become sclerosed, and the dense new bone produced must be excised in order that the medulla from either fragment should be allowed to sprout out, and, growing together, effectually re-establish the continuity of the shaft of the bone. But sclerosis of the ends of a fractured bone is a work of time, and hardly occurs within a period of six months, so that if after putting up a fracture we discover in some six or eight weeks that union has not taken place, we should give the patient chloroform, and rub the ends of the broken bone with considerable force against one another, so as to excite fresh action in the part, and break down any fibrous tissue between the ends of the bone, and then re-adjust the limb, taking the greatest care to get the fragments into accurate apposition, and to keep them absolutely at rest for two months. It is only after all other means for promoting the union between the broken ends of the bone have failed that we are justified in performing so serious an operation as cutting down upon the fracture, and removing the ends of the bone. If we are obliged to resort to such a proceeding, it will generally tend much to the success of the treatment if the extremities of the fractured bone are pierced by a drill, and tied together with silver wire. This treatment not only secures their being kept in apposition, but produces a certain amount of action in the part, which under the circumstances is frequently beneficial in its results.

Fractures of bone become much more complicated when the ends of the broken bone communicate with the external air through an opening in the skin—not that the actual union between the ends of the bone differs under these conditions from the process I have described in cases of simple fracture, but the admission of the atmosphere into a wound is liable to set up putrefactive changes in the organic materials it contains, and these decomposing substances, if absorbed into the venous sinuses of the medulla, poison the blood. Without discussing the nature of the putrefactive process, it is impossible to deny that the admission of the air of our wards into a wound will induce decomposition in the serum and other discharges, and it is equally certain that these matters, if absorbed into the circulation, will produce more or less septic poisoning. Consequently, in treating cases of compound fracture, we must endeavour either to make the best possible provision for the free drainage, or escape, of putrefying fluids from wound, or else by means of Mr. Lister's system of antiseptic dressing, we should prevent decomposition from occurring in the wound; in fact, turn the blood, serum, and what would otherwise be waste substances and a danger to the patient, into materials by means of which the reparative process may be quickly effected in the injured tissues.

Our choice, therefore, seems to lie between the open wound system and the antiseptic treatment, the question being—Is it better to leave wounds of the kind exposed to the air with no covering except the cradle to protect them from the bed clothes, or shall we employ Lister's method of treatment? We need hardly discuss the modifications of these systems of dressing wounds, because if you do not prevent putrefaction from taking place in the discharges from a wound, it is best to leave the part exposed, so that we can see and smell the discharges, and keep the wound as pure as possible, pus and other discharges being allowed to flow freely away into receptacles provided for them. I believe, however, that with ordinary care we can prevent putrefaction and suppuration from taking place in cases of compound fracture by Mr. Lister's system of dressing, and that this plan of treatment is, therefore, preferable to that of leaving wounds of the kind exposed to the air, because however free the drainage may be from the wound there is always considerable danger of absorption of putrid matter into the system. Practice confirms this idea, for pyæmia in adults is by no means uncommon after compound fracture treated by the open system; and supposing there was no danger to life under these circumstances from septic poisoning, still, so far as our hospital patients are concerned, the open plan is objectionable on account of the offensive and unwholesome smell it causes in the wards. Beyond this, suppuration from such a wound produces a considerable and unnecessary drain and waste of power in the system, and, further, matter forming and burrowing round the ends of an injured bone may strip the periosteum from the bone and by destroying the medulla lead to necrosis and its consequences.

Among my hospital cases in Calcutta in former years it was rather the exception than the rule for patients suffering from compound fractures of the lower limb to recover, their fate in the majority of cases being to die of pyæmia; the mortality was hardly less after primary amputation in accidents of the kind; but in later years, by the use of antiseptic dressings, compound fractures were almost as successfully treated as the simple.

Since leaving India I have seen the antiseptic treatment of compound fracture successfully carried out in several of the large continental cities, and in some of them, as for instance, in St. Petersburg and Moscow, under most unfavourable hygienic circumstances. Nevertheless, my own observations and the testimony of almost all the surgeons I have met who have honestly practised this treatment, in the class of cases I am now considering, has been uniformly favourable to the antiseptic treatment of compound fractures, so that I have no hesitation in recommending you to adopt it, in preference to leaving the wounds exposed to the air or covering them with any other dressings.

The danger at the present time is lest the unquestionable boon conferred by Mr. Lister on surgery should be brought into discredit by its injudicious employment. We hear, for instance, of the peritoneum, and joints, being opened under the spray, with a view, so far as one can learn, to demonstrate that dangerous injuries of the kind may be inflicted without risk, rather than for the rational cure of disease; let me warn you seriously against any such practice. I have never known a surgeon who has held any lasting reputation in the profession, or whose example and teaching were respected by his pupils and colleagues, commence an operation with a "light heart." However trivial the work to be performed, let it be undertaken with a sense of due responsibility, so that while exercising, what is unquestionably the highest aim of our profession, the cure or alleviation of disease by operative interference, our first and by far our most earnest consideration is the welfare of our patients, and, secondly only, our own reputation as surgeons. If these principles are kept in view there is no fear of the antiseptic treatment suffering at the hands of over-zealous practitioners, but it will take its place, as it is entitled to do, among the many advances made of late years in the art of surgery, and its beneficial effects will be recognized in no class of cases more conspicuously than in the treatment of compound fractures of the extremities. The following is a case in point reported for me by Mr. G. H. Butler, on the 4th February :—A. D., æt. thirty-four, met with an accident through the fall of an hydraulic lift by which he sustained a severe compound communicated fracture of the right fore-arm, besides several other injuries. On arriving at the hospital the wounded arm was covered up in folds of linen, soaked in carbolic oil. I was sent for by our house surgeon, Mr. Neale, who thought that it might be necessary to amputate the limb. I found both bones of the patient's fore-arm crushed, and several small pieces of the contused bones were taken away from a large wound in front of the arm. There was a similar wound at the back of the limb, the arm at the site of injury having been literally crushed. I could detect no pulse at the wrist, and the hand was cold, and without sensation. Although little hope was entertained of saving the limb, we determined to give the patient every chance, and syringed out the wounds carefully with a solution of carbolic acid (one part of acid to eighty of water) under the spray; as the external structures were so much lacerated on both sides of the limb, it was unnecessary to employ my horse-hair drainage, so that after thoroughly cleaning the bruised tissues we covered them with protective material and then packed the limb in shreds of antiseptic gauze over which an antiseptic dressing was closely applied, the whole being retained in place by means of carbolized bandages. The hand was wrapped in cotton wool and the limb laid on a pillow.

Two days after the first dressing a second was applied in the same way; the hand was still cold, and no pulse could be felt in the radial artery; the patient's temperature had not risen above 100°.

The dressings were now undisturbed for a week, by the end of which time warmth, and some amount of sensation, had returned to the hand, the wound looked remarkably healthy, there was no discharge whatever from it.

I will not trouble you with the further details of the case. Under Mr. Neale's careful dressing the patient's temperature never rose above 100°, and the broken bones united as though the accident had been a simple fracture, so that on the 6th March, or just one month after the injury, our patient was discharged from the hospital, as Mr. Butler remarks, "with the arm in good position, both wounds having entirely healed."

I do not affirm this result would not have been effected if other dressings had been employed, but I state my belief that no more speedy or satisfactory conclusion could have occurred in a case of this kind, and when one sees a number of instances of the same description following one another in unremitting succession, we may, I think, claim the result as due to Lister's system of dressing.

NECROSIS.

I have before remarked that in some cases of contusion of the medulla, in place of the effused blood becoming absorbed and the tissues resuming their normal functions, necrosis of the affected portion of the bone occurs, and I also stated that pus effused round the ends of a broken bone by burrowing into the periosteum and medulla occasionally leads to necrosis. In a case of acute osteomyelitis we found the whole of the shaft of the tibia necrosed; a portion of it was destroyed in the instance of syphilitic disease of the tibia. In another case of periostitis the death of the superficial layers of the fibula occurred, so that you will understand necrosis of bone means simply the death of a portion of the osseous tissue without reference to the causes which have brought about this result. It, however, as a rule, depends upon a defective supply of healthy blood to the affected tissues.

Limited necrosis, the result of contusions, wounds, or inflammation of bone, is of frequent occurrence, and we may explain its circumstances by reference to a case lately under my care in the H. Hoare ward.

In this instance the patient, from the nature of his occupation, was out of health; he was a compositor, and was employed for many hours of each day in a dark close room. He received a severe blow over the right fore-arm which entirely disabled him for upwards of a month; he then went to work again, the injured arm being still painful and swollen. Subsequently sinuses formed, and on his coming into the hospital fourteen months after the accident we found three openings in the arm leading down to dead bone (sequestrum). The necrosed portion of bone was evidently surrounded by a case of newly formed osseous tissue, so that I could not move it with a probe, and I consequently cut through the soft parts and peeled back the periosteum, I then broke away a portion of the bony envelope surrounding the sequestrum, which was readily removed It consisted of the whole thickness of the radius, and was two inches long. After taking away this piece of bone the wound in the arm gradually healed, and the patient left the hospital cured.

In this case it is probable that in consequence of the injury which the man had received, a portion of the medulla of his right radius was contused. The patient was in a low state of health at the time of the accident, and the circulation in a limited area of the interior of the injured bone was not thoroughly re-established; after the contusion it was, however, surrounded by living tissues rich in bone-forming cells.

In a case of the kind the entire thickness of one of the long bones having become necrosed, including, of course, the medulla which it contained, it is evident that new osseous tissue can only be produced from the surrounding periosteum covering the exterior of the necrosed bone, and from the medulla of the shaft in the midst of which the sequestrum rests. The dead bone, however, under these circumstances interferes in many ways with the healthy nutrition of the surrounding tissues, and the consequence is rapid and feeble cell-growth from the enveloping layers of living cells. Much of this superabundant cell formation is unable, from its physical circumstances, to reach maturity and so degenerates into pus, and this ultimately finds vent through sinuses, such as that which existed in this patient's arm before we operated upon it. But the periosteum not having been destroyed by the accident continues to live, its supply of blood being kept up from vessels contained in the neighbouring soft parts, and as in the case of a simple fracture, a layer of new bone forms round the seat of injury, but unlike a fracture in necrosis, the cause which excited the increased action in the periosteum continues, and so the external layer of new osseous tissue increases in bulk until it forms a thick case round the sequestrum. In the instance under consideration it was necessary to break through this new bone before we could extract the necrosed piece. After the sequestrum had been taken away, the source of irritation in the part being removed, healthy action took place from the medulla and periosteum, and filled up the cavity formerly occupied by dead bone.

We seldom have the opportunity of watching the growth of new bone from the soft structure contained in the cancellated tissue after the outer covering of the bone has been removed, and it is hardly likely we should have witnessed this phenomenon in the following instance, unless the accident had occurred, as it did, to a young child.

H. C. Jeffrey, æt. three and a half, was run over by an omnibus, one of the wheels passing against the right side of the child's head. A portion of the scalp was torn away from the skull, the whole of the parietal part of the temporal and frontal bones being exposed and denuded of pericranium. The flap of skin subsequently sloughed, leaving the bare bone uncovered ; in the course of two months thin plates of the external layer of the injured bone began to exfoliate; at the same time, small patches of a florid new growth sprouted up from the soft tissues contained in the diploe and remains of the outer table of the skull. These new growths afterwards coalesced, and over their surface a layer of connective tissue formed, beneath which ossification took place, the outer layer of the medulla, or that farthest from the circulation, becoming organised into fibrous tissue, the deeper layers into bone, verifying the idea I have so repeatedly insisted on as to the inherent power the medulla possesses according to the circumstances under which it is placed of forming either fibrous or osseous tissue. As the new bone was produced, in the manner I have described, the scalp round the edges of the wound grew inwards, and so the bare bone was covered by a healthy cicatricial tissue.

No doubt the favourable result in this instance was due to the tender age of the patient. In adults the termination is often different, as in the case of A. E., æt. fifty-six ; this man, four years ago, fell into the fire and burnt the back of his head, the result being extensive sloughing of the scalp. In the course of a couple of months a nearly circular surface of the skull, five inches in diameter, was laid bare, exposing the posterior angles of the parietals, with the upper part of the squama of the occipital bone; this surface of bare bone has remained exposed for four years without undergoing much change, a putrid discharge constantly oozing from under its edges. In one or two spots the outer layer of dead bone has broken down and a florid growth from beneath has filled the cavity thus formed, but as yet the necrosed outer table of the skull is firmly united to the soft tissues beneath, and I am therefore disposed to follow the rule of treatment generally applicable to dead bone, which is not to attempt to remove it until the necrosed bone is felt to be detached from the tissues amongst which it is situated, a rule, however, not wanting in exceptions, as I have illustrated in the instance of the patient referred to in this lecture, from whose arm I took away a sequestrum. The fact is, in operations for the removal of dead bone, as in almost all other matters connected with the practice of surgery, we must be guided more by common sense and the circumstances of each case as it presents itself to our notice, than by any fixed rule. The disadvantage of taking away dead bone before it has become loose in the surrounding structure is, that it is often impossible to determine until the diseased bone has separated from the living, how far the necrosis may extend. It is much the same as in gangrene of the limbs; it is seldom desirable to amputate unless a clear line of demarcation has formed between the dead and living portions of the limb, obviously because if we act otherwise our amputation may be short of the mark to which the gangrene will ultimately extend, and so another operation may be the least of the risks likely to result. It is the same with necrosis of the bones: if the separation between the dead and living bone has not taken place, it is generally advisable to have patience and wait until the sequestrum is detached, and can be moved either by means of a probe or the finger passed down upon it through sinuses in the surrounding soft structures. In operations of this kind you will find Esmarch's bandage of assistance, enabling you to distinguish between the dead and living bone more clearly than if the parts were bathed in blood during the operation. As a rule, necrosed bone is white, but if exposed to the air through open sinuses it may become of a dark, or even black colour.

It is useless entering into details regarding the method to be employed in removing a bit of dead bone. Having satisfied yourself that the sequestrum is detached, or having reason to believe that although you cannot feel it loose in the wound, that dead bone exists which requires to be taken away, cut down upon the diseased bone; it may be through a layer of new osseous tissue which has formed round it, in which case strip back the periosteum so as to preserve it, and then take away the dead bone with the most convenient instrument at hand. The wound should be plugged with dry lint, and subsequently carbolized oil, the red lotion, or any other dressing you prefer, applied, the limb being kept at rest on a splint during the time the healing process is going on.

In the case of A. E., I adopted a course of treatment which is useful in instances when the dead bone is exposed. It consists in applying a strong solution of sulphuric acid (six parts to one of water) over the surface of the bone, as recommended by Mr. Pollock, our object being to dissolve away the outer shell of the necrosed bone, but in doing so be careful not to destroy the living tissue beneath, from which alone the reparative process can subsequently proceed. In the ordinary course of things we find that reproduction of bone in cases of necrosis of the flat bones is rarely met with, except in young subjects, as in the instance I have already referred to. The formation of new osseous tissue after death of a portion of the skull is very uncommon, for the simple reason that the deeper layer of the pericranium and the medulla of the diploe having been destroyed in the diseased action, there are no elements left in the part from which fresh bone can be produced.

The same fact applies to cases of necrosis of the ilium. We had an instance in point in Chadwick ward for some time—a poor girl, æt. twenty-two, suffering from necrosis of the dorsum-ilii. I cut down to the bare bone and removed a portion of it. We tried all the means at our disposal to relieve the symptoms from which she suffered, but to no purpose; and, as I have frequently told you, I have watched cases of this kind for years, but I do not remember meeting with one that recovered. The sinuses may heal up, and all appears for a time to be doing well, but before long evidence of further bone mischief manifests itself, and so the case comes back upon our hands, suppuration continues, and ultimately tuberculosis of the lungs or some of the internal organs in all probability kills the patient.

I may here refer to necrosis resulting from the local action of phosphorus on the osseous-producing element of the periosteum and bone. That the deleterious influence of this substance depends upon its being brought into contact with these particles of living matter is demonstrated by the fact that as long as persons working in the fumes of phosphorus possess sound teeth their jaws remain healthy, but if they happen to suffer from dental caries, by which the tooth pulp is exposed, the phosphorus gains access to the subjacent periosteum and exerts its baneful power on the cells contained in its deeper layers.

The disease first manifests itself by pain and localized swelling of the gums, often referred by the patient to toothache. If the phosphorus fumes continue to be inhaled the pain in the jaw increases, becoming very severe, sympathetic action is excited along the nerves of the face, neck, and head, swelling and suppuration of the gums follow, and after a time sinuses leading down to dead bone are established, and in this way considerable portions of the upper and lower jaws may be destroyed. The conditions which directly influence the progress of the disease are the continued exposure to the phosphoric fumes, the state of the teeth, the general health and the hygienic circumstances under which the patient lives.

On examining specimens of these necrosed jaws we find the superficial portion is invariably of a dingy-blackish colour; the outer layers of the bone are destroyed, and the spongy portion of the alveolar process is exposed. The bone looks rough as if carious; it is filled with pus, and as it discharges, small pieces of bone escape which give the pus a gritty appearance. Examined microscopically we find these diseased bones afford evidence that ill-formed osseous structures had been produced in considerable quantity by the periosteum, and that the medulla occupying the Haversian canals and cancellated tissue of the bone have been destroyed; the increased action set up in these parts having in all probability been similar to that occurring in the periosteum, but being carried on in unyielding passages the vessels have been compressed and the circulation so far impeded as to lead to the death of the bone. On the other hand, the periosteum being supplied with blood by vessels contained in the soft tissues external to it, its osseous cells build up layer after layer of imperfectly formed bone. No doubt the presence of the dead bone keeps up a disturbance in the nutritive changes of the parts, for if it is removed the periosteum does its work more perfectly and produces a very fair osseous substitute for the bone that has been destroyed by disease.

Necrosis from phosphorus therefore presents nothing peculiar in the course which it runs. It is rather remarkable in consequence of the idea it seems to inculcate of the elective affinity between certain elementary substances and definite forms of living cells. Phosphorus fumes must be absorbed into the bodies of workmen employed in the manufacture of lucifer matches, and yet it appears to do them little harm unless they suffer from carious teeth; it may be the phosphorus becomes altered in the circulation, but it seems to be almost innocuous, unless brought into contact with the living descendants of the embryo-cartilage cells: it fixes upon them to the exclusion of the surrounding living matter, and evidently incites, if we may so say, these cells to ill-adjusted action, and so disease is set up such as I have described. We cannot be too careful in instances of necrosis from phosphorus to insist upon the removal of the patient from the influence of this substance in any shape or form. The patient's mouth must be washed out frequently with a solution of Condy, or carbolic acid; in fact, kept as clean as practicable. He should be fed on soup, milk, and vegetables, so as to improve his general health.

I am not an advocate in this or in any other form of necrosis of the jaw of making free incisions down to the diseased bone; we must have patience, simply removing decayed teeth and dead bone as soon as it has separated from the living structures, but not before, although in the meantime our patient has to suffer months, and it may even be years, of discomfort and annoyance. I have more than once in instances of necrosis of the jaw, not depending on phosphorus poison, endeavoured to take away the diseased bone before it had completely separated from the living structures around it: the temptation is often great to resort to treatment of the kind, for the terrible odour and discomfort persons suffering in this way have to undergo is extreme—nevertheless, take my advice and refuse, unless under some peculiar or exceptional circumstances, to interfere either with the knife or forceps until the sequestrum is detached from its surroundings.

Mr. Salter has occasionally met with necrosis, the result of the eruptive fevers—generally scarlatina. It commences after the active stage of the disease has passed off in tenderness of the gums, fœtid breath, but no severe inflammatory action; the gums recede from about the teeth and bare bone is exposed, this exfoliates after a few weeks, leaving a gap in the jaw, which gradually fills up with new bone. Mr. Salter considers this form of necrosis to be similar in its nature to that produced by the fumes of phosphorus, "the poison being, however, generated in the system, but having affinities for definite structures and tendencies to action upon certain organs, which give its morbid consequences an equally local character." Necrosis, under these circumstances, must be of rare occurrence, considering the number of children afflicted by the eruptive fever who escape any such accident;

and, fortunately, when it does happen it seldom extends beyond the *locale* containing the developing permanent teeth, the base of the jaw hardly ever being involved in the diseased action.

We occasionally meet with cases of necrosis, which run much the same, although (from the construction of the osseous tissues) a slower course than senile gangrene. Mr. W. Morrant Baker brought an instance of the kind to the notice of the Medico-Chirurgical Society on the 27th February, 1877. His patient was a man who was quite well ten weeks before admission into St. Bartholomew's Hospital, when he began to suffer from deep-seated pain, soon followed by a slight swelling in the left thigh. These symptoms gradually increased, and some six weeks after the commencement of his illness, while walking, a fracture of the middle of the femur occurred. The thigh became much swollen, the integuments were natural, and no abnormal condition of the soft parts between them and the tumour of the bone could be discovered. There was great pain in the limb, and the case was taken to be one of malignant tumour of the femur. Amputation at the hip-joint was successfully performed, and the patient left the hospital cured.

On making a section of the femur it was found that nearly the whole of the shaft was necrosed, "except at its posterior and upper part, where the bone is sclerosed and much enlarged, but not dead; while suggesting a possible reason for this, there lies exposed as it happens by the section the canal for a large nutrient artery, the calibre of which has not been interfered with." The necrosis hardly extended to the trochanters, the condyles were hypertrophied. The shaft of the femur, from above the cartilages of the condyles to the trochanters, around its whole circumference, was contained in a thick envelope of newly formed osseous tissue produced from the periosteum.

This is an example of a class of cases which we meet with from time to time of necrosis of bone without suppuration. Sir James Paget referring to an instance of the kind, remarks that "the central point of interest in these cases is, I think, the fact of necrosis leading to separation of bone being unattended with inflammation of any of the textures external to the periosteum, or with more than a scarcely discernible amount of suppuration around the sequestrum."

I have already referred to the condition of a patient suffering from inherited syphilis, in which we found the lower end of the tibia much enlarged from newly-formed periosteal bone, and in which necrosis was progressing at the time we amputated the limb. When lecturing on this case I remarked that one of the characteristics of these syphilitic affections was that death of the bone was apt to take place without suppuration.

Necrosis of the whole or a portion of one of the long bones may also occur without the formation of pus in cases of embolism of the nutrient vessels of the bone; it may be the principal artery or some of the smaller vessels become plugged, but embolism of these arteries has been demonstrated, and the natural consequence of such an accident occurring in a structure like bone is the death of the part previously supplied by the plugged vessel, in the same way as necrosis of the kidney takes place after embolism of the renal artery. The evidence afforded by the history of some of the cases I have referred to seems to point to embolism of their principal nutrient artery. The fact of the bone supplied by this vessel being generally necrosed, whereas the ends of the femur receiving vessels through the periosteum remaining unaffected, for instance in the case of necrosis without suppuration above noticed, the only part of the shaft of the femur not necrosed was a portion of the bone under the influence of a nutrient vessel, "the calibre of which was not interfered with." Then again, the rapid and very abundant periosteal growth noticed in these cases point to the conclusion of embolism, an extensive collateral circulation under the circumstances being established, which would necessarily induce hyperaction of the whole of the periosteal vessels of the shaft of the bone, and congestion of these vessels means increased growth of the periosteal osseous-forming elements, and so the development of the thick envelope of bone in which the shaft of this femur was encased.

It may be well for me to repeat the warning I have already given you not to judge hastily of the nature of the disease leading to rapid enlargement without suppuration of one of the long bones, or to pass to the conclusion that an affection of the kind depends either upon ostitis or to malignant disease, for these symptoms may clearly also depend on syphilitic affections of the periosteum or to embolism of the nutrient artery of the bone.

CARIES.

It is, however, well to remark that periostitis leading to the growth of a considerable quantity of new bone is commonly the result of that stage of syphilis which is accompanied with eruption over the skin, the poison during this period of the disease producing changes in the nutrition of the periosteum, the outcome of which is increased action of the osseous-forming cells of the part, and then the abnormal development of bone; on the other hand, in the advanced stages of syphilis the disease usually manifests itself in the periosteum (rarely in the medulla) in the form of gummata, which after a time may become entirely absorbed, or may degenerate into a soft jelly-like material, leading to the molecular disintegration or caries of the structures in which they are situated.

Syphilitic nodes might therefore be conveniently classed under two heads—the one as a rule being due to the formation of osseous tissue, the other to gummatous swellings. The former are accompanied with severe pain, affecting especially the bones of the sternum, clavicle, ulna, and tibia; there is an elevation of temperature at night, and general ill-health. The gummatous nodes, on the other hand, are frequently painless growths; the patient has but slight, if any fever, and often remains in good health. These gummy tumours of the surface of bone have often been confounded with osseous formations, and it is only recently that the idea has been abandoned that elastic flattened swellings of the kind did not depend on an exudation of plastic materials from the blood between the periosteum and the bone; they are now, however, admitted to be due to the growth of a soft tissue in the deeper layers of the periosteum. This tissue is formed of a gelatinous intercellular substance, here and there fibrillary, with proliferating cells—some fusiform, others round—of different size, for the most part pale, and produced with one, less often two or more, pale nuclei. One of the most obvious features of this growth is its extreme fragility—the rapid destruction of its cells by a process of fatty metamorphosis or conversion into caseous material—so that its natural history is not unlike that of tuberculous formations in bone, and like tubercle, from which I hardly think its elements can be distinguished under the microscope, as it degenerates, the tissues it has invaded are disintegrated, and if the effete products of their decay escape externally, an ulcer is produced, or, in the structure we are considering, caries of the affected bone occurs.

Periosteal gummata never have a long duration, differing in this respect from the osseous nodes; if their existence is prolonged, it depends on the production of new elements in the neighbouring parts; but, as a rule, gummata, after reaching a variable size, degenerate, and as they disappear there is a flattening or depression left in the site they occupied.

With reference to the diagnosis of periosteal gumma, I may remark that in compressible periosteal growths, whether originating on the bones of the extremities, trunk, or face, our first inquiry must be directed towards determining if the patient is the subject of inherited or of acquired syphilis; a careful cross-examination will frequently be necessary in order to enable us to arrive at the truth in this matter. Cases of the kind are not uncommonly complicated by the effect of an ill-conducted mercurial treatment, for, strongly as I advocate the judicious administration of this drug in cases of syphilis, few surgeons have seen more of its ill effects when abused than I have. With a syphilitic history, a painless, compressible, rather rapid formation, springing from the periosteum, is probably a gumma; and as a growth of this kind often involves the greater portion of the circumference of a bone, it may give us the impression that the swelling is produced by an expansion of the substance of the bone. Such a growth might be due to sarcomatous or medullary disease, but a few weeks' treatment with iodide of potassium will settle the point, and in a doubtful case it would be well to resort to a test of the kind, and by means of an exploratory puncture, to gain further information before arriving at a final conclusion in the early stages of the disease. When more than one gumma exists, or the skin over the tumour has ulcerated, the diagnosis will be rendered comparatively simple.

My own observations lead me to differ from the opinions held by Mr. Stanley, that "syphilis produces its effect mostly upon the compact tissue of bone." On the other hand, changes such as I have described within the bone are of rare occurrence in comparison with those which take place in the periosteum, the medullary structures as a rule being implicated by gumma which form external to the osseous tissue, so that the caries of syphilis in its early stages is usually superficial, whereas that of tuberculous inflammation, commencing, as it does, in the medulla, implicates the cancellated tissue, which is apt to crumble down under its action into a soft gritty material resembling mortar.

Caries of bone can hardly be mistaken, for a probe, or the finger passed down through sinuses leads to the exposed, softened, rough bone, which readily bleeds when touched. The discharge varies with the condition of the parts and the health of the patient, but it has seldom the fœtid offensive smell of putrid bone. As I have before explained, even in long-standing cases of tuberculous disease of the medulla, there are frequently sufficient healthy cells in the part to produce bone, and so repair the mischief effected by the disease. The same remark applies to syphilitic caries, but under any circumstances we must fully recognise the fact that caries is a manifestation or result of constitutional affections, and employ our curative treatment accordingly. In syphilitic affections of bone, the longer I practise the more convinced I am that whatever the stage of the disease, mercury is the sheet anchor on which we must rely for the alleviation of this affection—I may add, for its cure. A slowly and carefully administered mercurial course of treatment, supplemented by fresh air, light, cleanliness, and good food, are the remedies I advise you to make use of. Should the circumstances of the case be such as to render it unadvisable to administer mercury, iodide of potassium in full doses may be given, but I cannot advise you to substitute this drug in place of the treatment above indicated except as a palliative.

I must refer you to my lecture on tuberculous diseases of bone for the treatment of cases of caries arising from that affection.

LECTURE IX.

RICKETS.

GENTLEMEN,—The notes of the following cases have been kept by my dresser (Mr. Sydney Smyth). They illustrate the clinical history of the disease we have to study to-day :—Emily R., aged five years, was admitted into the Chadwick ward. Her father and mother are healthy well-to-do people living at Chelsea. We instituted careful enquiries regarding their family, and arrived at the conclusion that there was no evidence whatever of rickets or any hereditary disease in the history of this case. The child's mother has been married nine years, and during that time has had seven children ; they are all living. The eldest girl has disease of the heart, and, like her brothers and sisters, marked deformity of the thorax and enlargement of the extremities of the ribs at their junction with the cartilages of the sternum, together with the square-shaped head and other characteristic features of rickets. Another of the children, an infant, had repeated attacks of laryngismus, and a third, two fits of convulsions.

Our patient's mother informs us that, when her children were about a month old, she was in the habit of feeding them upon bread and milk; it is true she also gave them the breast, but her supply of milk was very limited. After her children had become six or seven months old she allowed them to take small quantities of mashed potatoes and anything else on the table they could swallow; they were very fond of tea. As a rule, these children suffered from diarrhœa, and from profuse perspirations, which flowed for nights together from the skin of their head and neck.

At the time of our patient's birth Mrs. R. was very ill, and, consequently, had even less breast milk than usual for her infant, so that in truth the child was reared on bread and milk until she was about seven months old, when she was fed on anything she could manage to consume. The child suffered from long continued diarrhœa; and, when about eight months old, she commenced perspiring at night profusely from her head and neck; she was extremely restless when laid down to sleep, rolling her head about from side to side, tossing off her blankets and refusing to be covered even with a sheet.

Emily R. was backward in teething; she cut her first tooth when fourteen months old, and had not completed her dentition until she was three and a half years of age; she was four years old before she attempted to walk.

On admission into hospital, the child was pale, but well nourished, short for her age, with a small face, making the bones of her head appear larger than natural. The fontanelles had closed, no depressions could be felt along the course of any of the sutures of the skull. The child's upper teeth are imperfectly covered with enamel, her tonsils are so much enlarged as to meet in the median line of the throat. Her chest is narrow in front, the sternum prominent, and her ribs at the junction with the cartilages of the sternum present well-marked nodular swellings; the sternal end of her clavicles are enlarged, and also the extremities of the long bones of her upper and lower limbs.

Our patient was admitted into the hospital in consequence of the existing deformities of her legs, which are knock-kneed to such an extent that she can hardly walk from one bed to another; for, after placing her left foot on the ground, the knee bends so much inwards that she cannot bring the right leg (affected in the same way) forwards. This is, in fact, a case of exaggerated genu-vulgum, and, like many instances of the kind, the deformity is increased by weakness of the internal lateral ligaments of the knee-joint.

The patient's femurs were curved and distorted; but, on carefully examining the bones of the leg, we came to the conclusion that they were sufficiently soft to enable us to hope that we might bend them by means of mechanical appliances into a better position than at present.

Mr. Neale, our House Surgeon, made a Hamilton's splint for the child, but, in place of the upper cross bar, the splint was secured to the body by means of a plaster of Paris bandage. At the end of a month's time this splint was removed, and the legs and thighs were surrounded by a leather case. The patient was ordered cod-liver oil and the lacto-phosphate of iron. Under treatment of this kind continued for several months she has certainly improved, and is able to walk about and go up and down stairs without inconvenience.

It is difficult to determine the earliest period of life at which symptoms of rickets may occur. Some authorities believe they have detected the disease at birth, but it may be laid down as a general rule that this affection is essentially one of infancy and childhood, and commences from the fourth or fifth month after birth until the end of the second year.

Subsequently, it manifests itself less frequently as the child grows older, and may be said never to commence after a child has attained his seventh year.

It is, of course, quite possible that rickets, having been developed in early life, its progress may become arrested for a time, and then from untoward circumstances it may make more active advance; but instances of this kind do not invalidate the rule above referred to. The truth is, that in early life the framework of the body has comparatively unimportant functions to perform, and it is not until called upon to act as a mechanical support to the trunk and limbs, or as a fixed point from which the muscles act, that we begin to detect the more obvious lesions produced by rickets on the osseous structures.

Without entering at present into the nature of the causes which give rise to the affection, it is evident that the abnormal state of the bones is by no means the only ill-effect of the disease on the system, for patients suffering from rickets present other and well-marked symptoms, the existence of which are plainly indicated in the history of the case I have just read to you.

In the first place, I would direct your attention to the account which Mrs. R. gives us of the profuse perspirations from the head and neck, from which her child suffered. This is an almost constant symptom attending the early stages of rickets. Soon after the child was laid down to rest for the night, her scalp, neck and shoulders were covered with perspiration which soaked the pillow on which her head rested.

Under these circumstances the thermometer does not show a constant rise of temperature; sometimes the mercury goes up to 100°; but as often it remains at the normal point; the child, however, is extremely restless, tossing his head about from side to side, and often kicking off all the bed clothes, refusing to be covered even with a light sheet.

This restlessness may not, however, be due to a feverish condition, but to a general tenderness of the surface of the body; for children suffering from rickets sometimes evince unmistakeable symptoms of pain if raised from the bed, or if the slightest pressure is made over any part of the body. It is difficult to account for this condition, but the general tenderness of the surface of the body, together with the restlessness and profuse perspiration of the head and neck, are well-marked symptoms of the early stages of rickets.

As a rule, children affected with this disease suffer, as E. R. did, from diarrhœa; the stools contain mucus, are green, frothy, and have an acid reaction. This disordered state of the bowels, together with the perspirations, naturally tend to weaken the patient, and he becomes anæmic, but unless in severe cases, does not generally lose flesh; his appearance is more that of a pale flabby child than of an emaciated one.

The veins of the head and neck are often unusually prominent, and some authorities maintain that the excessive perspiration from the skin of the parts is due to the engorged condition of the cutaneous vessels. There seems to be some truth in this idea; for, as I before remarked, the thermometer gives us information to the effect that, as a rule, the patient does not suffer from febrile disturbance.

Supposing, therefore, you are called to see a case in which the above symptoms are more or less prominently marked, your suspicions will be at once excited as to the existence of rickets, especially if the patient is from five months to two years old; for, as I said before, this as a general rule is the time of life when the disease commences; and, under these circumstances, you would not fail to go farther into the particulars of the case, and the chances are you would meet with unequivocal evidences as to the presence of the affection we are now studying.

The first of these unquestionable symptoms of the disease is the enlargement of the ends of the ribs, at the line of their junction with the costal cartilages. They are beaded or nodulated, and when once you have felt the part affected in this way, you will never be in doubt as to its existence or otherwise. But it is well to bear in mind the fact that the swelling may occur principally on the inner surface of the ribs; nevertheless, if a careful examination of the thorax be made, especially over the extremities of the middle ribs on the left side of the chest, the nodulated condition of the bones will readily be detected even at the commencement of rickets.

I have already remarked that abnormalities in the bones are not so apparent in the earliest stages of rickets as they otherwise might be, because the functions which the skeleton has to perform is of a comparatively unimportant nature, but there is an exception to this rule in the circumstances of the bones entering into the construction of the chest; the ribs must not only move, but resist atmospheric pressure from the very first minute of life, and so it is at the points in these bones where nutritive changes are most active at the lines of growth, that the earliest symptoms of rickets in the osseous system are observed. This beading of the ends of the ribs has been noticed in children suffering from rickets six weeks after birth.

Alterations in the condition of the occipital bone have been found in cases of rickets at a very early age, and they are almost as constant in this disease as abnormalities of the ribs, but they are not quite so easily detected.

In examining the occipital bone in instances of this kind, the child's head must be fixed, and the surgeon should then carefully press his fingers perpendicularly over the integument covering the occipital bone and posterior portions of the parietal. Should rickets exist, he will generally feel several small round or oval soft spots, situated within the sutural margins of these bones. These spots are unossified portions of the medullary structures from which the bone is produced.

I hold, of course, that whether the formation of bone takes place from a membrane, the counterpart of the periosteum, or from temporary cartilage, it is produced from one and the same histological elements.

The number of soft spots varies considerably; in some cases only one of these can be felt, in others as many as ten or a dozen; but I have never been able to satisfy myself that fresh spots of this kind have occurred in those portions of the occipital bone which have once been calcified. I have frequently mapped out these depressions with nitrate of silver, leaving the other portions of the bone uncovered, and I cannot say I have discovered soft spots making their appearance in those parts of the bone which have once become hard and firm.

It is a mistake to suppose that in this condition (known as cranio-tabes) the soft spots referred to are literally perforations in the cranium. In the instances I have had an opportunity of examining, the bone-forming elements fill the deficiencies in the bones, intervening in fact between the dura mater and the pericranium. The small round cells of the medulla are seen encased in their soft hyaline surrounding, but into this homogeneous material they have failed to secrete any bone earth; in fact, these spots are literally small fontanelles, and, as a rule, in any particular case they close about the same time as the larger fontanelle openings do. Cranio-tabes is present in forty-five per cent. of all instances of rickets.

The occipital bone is often remarkably thin in cases of this disease. The sagittal and coronal sutures may remain open until the patient is eighteen months old; the two halves of the frontal bone sometimes continue un-united for a year after birth, and the anterior fontanelle may still be patent, although the child be four or five years of age. Our patient's head was of the peculiar square type so characteristic of rickets, the centres of ossifications in each bone becoming developed and more prominent than the rest of the skull.

The frontal sinuses are, like the bones of the face, small in comparison with the skull, so that at the first glance we are apt to assume the latter to be larger than it should be, but such is not often the case in rickets; the proportions of the head and face in these cases are determined by the same developmental defect which prevails throughout the body, the skeleton retaining the infantile type, so that we might almost suppose the fœtal skeleton to have remained cartilaginous and grown in place of being transformed into bone; thus, the face remains small in comparison with the skull, and the thighs and arms are short in comparison with the legs and forearms.

In connection with the alterations I have described in the bones of the skull, I may refer to disorders of the nervous system not unfrequently met with in rickets. These affections are considered by some authorities to depend upon pressure on the brain from without, through the soft spots observed in the occipital and parietal bones. For instance, one of E. R.'s sisters suffered from attacks of laryngismus; another sister had several fits of convulsions.

Laryngismus is by no means of unfrequent occurrence among children suffering from rickets; and, as the spasmodic attacks almost invariably come on at night after the child is laid down to rest, it is possible they may be occasioned by pressure upon the brain through the openings in the occipital bone. However this may be, it seems certain there is a direct connection between the laryngismus and the rickets, and that, if the latter is overcome, the former may be cured; in fact, in instances of the kind we must direct our attention to the general ill-health of the patient rather than to the local manifestations of the disease in the larynx.

The same remark is applicable to the attacks of convulsions. In spite of much that has been written to the contrary, I am convinced that the practice of lancing the gums frequently relieves the pain and local irritation, which unquestionably exist in many otherwise healthy children during dentition. At the same time I readily admit that dentition may be delayed, and generally is so in rickets, and that in cases of this kind it can be of little use to lance the gums for the relief of attacks of convulsions; but then we have clear indications to guide us with reference to doubts we may entertain on the subject; for, if the backward dentition and the convulsions are due to rickets, there will be the beaded ends of the ribs, open sutures and fontanelles, perspiration and restlessness, together with other symptoms pointing distinctly to the nature of the malady from which our patient is suffering.

While the changes I have described as taking place in the ribs and bones of the skull are progressing, the lower extremities of the radius and ulna frequently become swollen, and in fact bulbous enlargement of the ends of all the long bones is characteristic of the disease. This condition of the bones is evidently most readily detected in those parts of the body which are only thinly surrounded with muscular and other soft structures.

But I wish to draw your attentions to these specimens of rickety bones. You will observe that while the epiphyses, or rather the extremities of this radius and tibia, are bulbous, the shaft of the bone is of its normal length and calibre. No doubt many bones affected with rickets are shorter than natural in consequence of the peculiar curvature which they assume, their distorted growth being the most prominent and obvious effect of the disease. These dense hard bones are as characteristic in after life as the soft pliable one is of the early stages of this affection.

It is impossible to lay down any hard and fast rules as to the time of life when the bones affected by rickets change from the soft into the hard condition. In some instances calcification of the osseous tissue commences when the child is four or five years of age; in others it is delayed until the tenth or twelfth year. It is important to bear this in mind, because so long as the bones are soft it may be possible to overcome their contorted condition by mechanical appliances; when once they are calcified, but little can be expected by means of this kind. Nevertheless, the distorted bones of rickets frequently improve greatly during early life and as long as the child continues to grow, because the diseased action or cause of rickets ceases after the patient reaches his third or fourth year of age, and then the laws governing the normal and symmetrical form of the body exercise their supremacy over the abnormal condition, and the bent bones have a tendency as they increase in size to assume their natural form.

In females one of the most serious deformities that occur under these circumstances is in the bones of the pelvis, the opening through its brim being sometimes so much contracted that it interferes with the passage of the head of the fœtus during parturition.

The bodies of the vertebræ, like the bones of the tarsus and carpus, are seldom implicated in rickets. It is true, from the weakness of the ligaments, the natural curvatures of the spinal column may become exaggerated, and so we meet with humped backs and a still more serious curving forwards of the lumbar vertebræ in this disease. Lateral curvature also takes place from weakness of some particular set of muscles; but serious disease of the spine, such as we so frequently see in tubercular inflammation of the bones, is never met with in cases of rickets.

The thorax is much altered in shape, as in the instance of E. R., the ribs being abnormally straight between their nodules and angles, a sulcus is formed running along the side of the chest, beginning about the nipple; it increases in breadth as it passes downwards. The cartilages of the ribs are usually depressed, and there is a transverse constriction on a line with the xyphoid cartilage. As Sir W. Jenner remarks, if you wish to study the characteristic form of a rachitic thorax, you have an admirable example of it in children during a paroxysm of whooping cough.

Our patient's eldest sister suffered from extensive disease of the heart; she had never had an attack of rheumatism, and it seems more than probable, that the instances of cardiac disease met with in rickety children are usually due to the mechanical deformity of the bones of the thorax.

With reference to the internal organs of the body, we know of no abnormal changes which can be said to be in any way characteristic of rickets.

Before entering on the study of the pathology of disease, I may remark that rickets is in a great measure an affection attending the advance of civilization and the crowding of families into large cities. Thus nearly thirty per cent. of the children admitted into the Metropolitan hospitals are affected more or less with rickets. The same observation applies to the population of Manchester and other large towns, not only in England, but also in America and the Continent of Europe. The disease, however, is not engendered by poverty alone, because the children of the upper classes suffer from rickets in as high a ratio as their poorer fellow countrymen. On the other hand, if we turn from Europe and America to the population of India, I might almost say of Asia, we seldom (and so far as my experience goes never) meet with cases of rickets among the natives, however poor and degraded the race may be; in truth, the more debased the tribe, the nearer the lower animals in their habits, the less subject to rickets are they. This fact to my mind has an important bearing on the etiology of the disease.

I argued in a former lecture on somewhat similar data, that concussions or injuries of the cancellated tissue of the bones in the neighbourhood of the larger joints could hardly be the cause of the numerous cases of diseased bone we meet with in this country; because native children, who are equally subject to injuries, very rarely indeed suffer in this way, in all probability because they are less commonly affected with tuberculosis, living as they do night and day through the greater part of the year in the open air.

Further than this, rickets is so generally preceded by diarrhœa, that some surgeons have supposed that the changes noticed in the bones are an effect of the disordered state of the bowels; but this cannot be the true pathology of the disease, because diarrhœa and dysentery, both chronic and acute, are the principle causes of death among the children of natives in India; but, as I have before remarked, they do not suffer from rickets.

There is, however, a marked difference in the system of rearing children in India and in this country; the native mother, however poor or rich she may be, invariably suckles her own child. Unless perhaps in the Presidency towns, no native would know the meaning of a feeding bottle; very few of them have perhaps ever seen one. If they have not sufficient nourishment for their infants, the probabilities are before long the little things die from inanition; but, until they can chew rice, they get nothing but their mother's milk to exist upon.

How different is the system in this and other civilized countries! The history of the patient now before us is a case in point; the child was fed on little more than bread and water (for we know what the milk supplied to the poorer classes of London consists of) until she was seven months old.

In examining rickety bones, and in fact in all abnormal osseous tissue, it is necessary to have injected specimens, and then, having made fine sections, to allow them to soak in a fifty per cent. solution of chromic acid and glycerine. It is of course out of the question attempting to grind down sections of this kind.

Selecting, therefore, a well-injected specimen from a child of two years old, when of course the bones are soft, and making sections through the epiphysis and the diaphysis into the cancellated tissue of the shaft, we are struck with the number of processes of medulla projecting into the temporary cartilage beyond the line of ossification (Fig. 4). As I have often explained to you, it is the

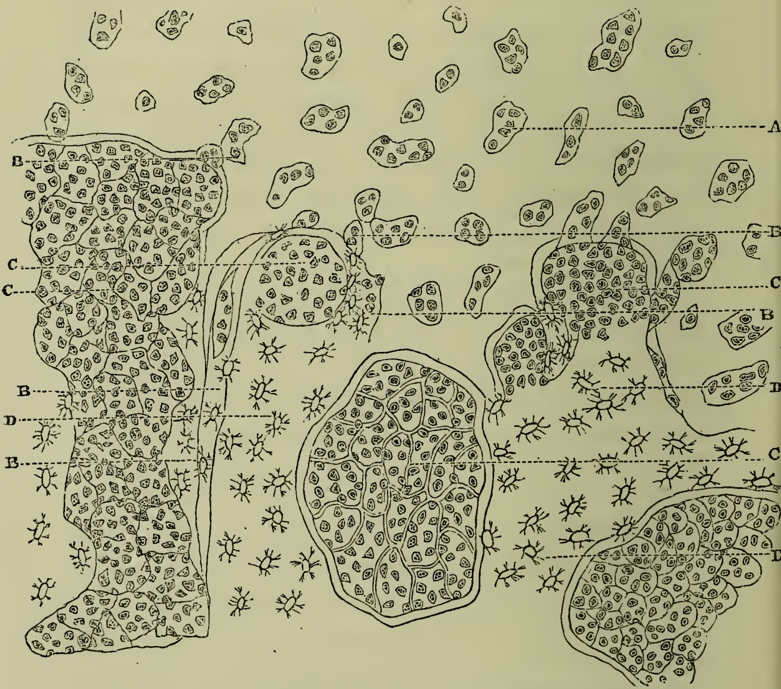

FIG. 4.—Section through articular cartilage and subjacent portion of bone in a case of rickets.
A. Cartilage cells.
B.B. B.B. Cartilage cells being absorbed into the spaces of the cancellated tissue of bone where they constitute a portion of the round cells of the medulla; some of these cells are being transformed into bone corpuscles.
C.C. Medullary structure in cancellated spaces.
D.D. Bone corpuscles of trabeculæ.

outer cells of these processes of medulla, derived from the cartilage cells, which in health form a soft hyaline material round themselves, into which they secrete bone earth. We find a precisely analogous condition in the deeper layers of the periosteum, which is a prolongation of the temporary cartilage over the shaft of the bone.

Here, in rickets, we see an accumulation of round cells, looking very like granulation tissue, produced by the proliferation of the cells uncontrolled by the process of calcification. Within the bone, the medulla appears to be in excess; its cells fail to deposit bone earth in their hyaline material, so that the medulla is not confined within its natural bounds by hard bony trabeculæ, and it sprouts out, as in these specimens; we observe but slight indications of ossific plates forming round the medulla, so that any section we make through the end of this bone contains much more medulla than a normal specimen would do, and the part is more vascular than in health. The consequence is that a vast number of healthy bone-forming cells are ready to commence work as soon as they are furnished with the necessary materials, and they then produce the exceedingly dense hard osseous structure so characteristic of the calcified rickety bones. Before this stage of the disease, doubtless, the cells of the medulla, including those of the periosteum, had performed part of their functions—they had constructed the hyaline material of the bone, but there was a deficiency of bone earth in the part to render the structure hard, very much, as I before remarked, as if we were to place a soft foraminifer in distilled water and expected it under these conditions to encase itself in a shell. The thing is impossible, and so I believe it is out of the question for the round cells of the medulla to form hard bone in the case of infants fed as our little patient was, during the first years of life.

In some of these cases chemical analysis demonstrates that these rickety bones contain only about one-half the normal quantity of earthy matter.

There seems to be something in the mother's milk essential to the perfect elaboration of the osseous system; and, if it is withheld, the consequences are, too frequently, rickets with all its complications.

No sooner is the child able to masticate, and the glands of its stomach and intestinal canal are fully formed, so that he can assimilate miscellaneous articles of food, than the blood takes up the chemical constituents necessary to hardening the medullary structure, and dense bone is rapidly produced. The beading of the ribs and enlarged ends of the radius, tibia, and so on are due to the bulging outwards from pressure exercised on the soft extremities of the bones. The remarkable curvature of the bones in rickets is the result of the same cause.

From a consideration of these facts you will probably agree with me, that we have good reason to suppose that the cause of rickets is not after all a great mystery; it is evident that the fault upon which all the mischief depends originates soon after birth, before dentition is completed.

Hereditary tendencies perhaps have something to do with this affection, but it is equally certain that, in the majority of cases, there is no trace of hereditary disease in the families of rickety subjects.

Rickets affects the rich and poor alike, and the more carefully we examine into the circumstances of individual cases the more evident it becomes that hand feeding during the first year of a child's life is at the root of the evil—an idea, as I have before said, strengthened by the fact that neither poverty nor any other cause will induce the disease among infants nursed by their mothers. Clinical experience, as Dr. Parry of Philadelphia so ably argues, teaches us the same lesson; for, if we recognise the affection in its early stages, and insist on the patient being fed on proper food, the symptoms from which he may have been suffering disappear.

It may be impossible, especially in the case of poor children, to provide a healthy wet nurse, but much may be done by careful directions as to the infant's diet; and, in addition, by ordering cod-liver oil and the lacto-phosphate of iron. It is surprising how speedily a rickety child improves under treatment of this kind.

I dwelt at greater length than might have seemed necessary to you on the symptoms indicating the commencement of rickets; but you will understand the importance of appreciating the circumstances attending the onset of the disease, for if you recognise it in its early stages and apply treatment based on the principles above indicated, you may effectually cure the malady.

Supposing, however, the child has grown out of the first stage of rickets, and you are consulted regarding the deformities resulting from the abnormally soft condition of the bones, the question will arise, what are you then to do? As I have before remarked, a child's age is no criterion as to the state of the osseous structures. In some cases the bones remain soft until the patient is eight or ten years of age; and, so long as this is their condition, you will evidently endeavour to straighten the distorted limbs, and to keep the child from bearing the weight of his body upon them.

In cases where the curvature of the limbs is very great, and the bones have already become hard, it is wonderful how much they improve in the course of a few years.

Rickety children frequently grow up to be remarkably powerful, healthy individuals, so that I would limit any operative proceedings in rickets to those instances in which the abnormal condition of the bones is so great that the patient is unable to walk. Under these circumstances we are unquestionably justified in dividing the curved bones or in excising a wedge-shaped piece out of them, so as to straighten the distorted limb. Many cases of the kind are now on record, where the happiest results have succeeded operations of this description.

It would be beyond my province to describe the surgical proceedings necessary in instances of the kind; in fact almost every case will require manipulation according to its special deformity, and the same remark applies to the mechanical appliances to be made use of in the earlier stage of rickets when the bones are soft, and may be moulded into something approaching their natural form. In going round the wards you will observe for yourselves the practice we adopt in these cases, always bearing in mind the unquestionable fact, that, under well-regulated diet, cod-liver oil and iron, many unpromising cases of rickets greatly improve; and, unless these matters are scrupulously attended to, no mechanical appliances, however ingenious they may be, will succeed in overcoming these deformities.

This fact cannot be too strongly insisted upon, that the terribly distorted bones we so often meet with in connection with rickets are clearly the result of negligence on the part of parents, and too often of the medical practitioner in charge of cases of this kind. It is precisely the same thing with the various deformities of the foot, known as talipes valgus, verus, and so on. It is impossible to doubt the statement that infants suffering from the worst deformities of this description may be entirely cured by means of well-applied straps and bandages, but the longer cases of this kind remain unrelieved the more difficult it becomes to overcome the mal-position the foot has assumed. And so with rickets, if, so soon as symptoms of the disease manifest themselves, the patient were properly fed and the yielding bones straightened, supported, and relieved from undue pressure, we should seldom meet with the deformities which are now of such frequent occurrence.

LECTURE X.

ON MOLLITIES-OSSIUM (OSTEO-MALACIA) AND DEGENERATION OF BONE.

Gentlemen,—The subject which will principally occupy our attention to-day is the brittle condition of the bone occasionally met with among people advanced in years, leading to fracture of the neck of the femur. Instances of the kind are seldom absent from the wards of our hospital, and we can, therefore, consider the matter in connection with a case under treatment at the present time. I think, however, this is a favourable opportunity for me to refer to an affection which we fortunately rarely see in practice, known as mollities-ossium, an inappropriate name, which has led to no little misunderstanding regarding the nature of this condition, for, in truth, the bones of a young child suffering from rickets are soft in the first instance, and yet mollities-ossium and rickets are totally different forms of disease. In the latter the bone is soft because it has not been rendered hard by the deposit of earthy matter in its hyaline matrix; in the former the bone is soft and pliable in consequence of the loss of its calcareous particles and, to a great extent, of its hyaline structure also; the one is an affection of infancy, the other never comes on until after puberty.

I have a specimen here, the femur of a female patient formerly in this hospital, under the care of Mr. H. Thompson, suffering from the disease we are considering. "She gradually became diminutive. Her legs and thighs could be bent. She died in consequence of softening occurring in the bones of the thorax. Upon a post-mortem examination her femurs could actually be tied in a knot." In the catalogue of our museum, the preparation is described as being "a longitudinal section of the right femur, affected with mollities-ossium. The shaft of the bone seems to be the part chiefly affected; the cancellated tissue is pretty distinct in the head and great trochanters, and dimly visible in the condyles. In both parts, however, the cells of the bone are filled with fatty matter, which is the most abundant in the condyles. In the shaft of the bone scarcely any remains of cancellous tissue are visible. Large spaces occupy its places, of irregular form and various dimensions. The spaces near the upper part of the bone are about the size of a bean, are smooth, but the parietes of the lower ones are irregular masses of fatty matter projecting into the interior about the middle of the shaft. The bone is curiously bent upon itself and bulged or nodulated. Upon its exterior a thin external investment of lamelliform tissue may be traced almost throughout the bone. The whole length of the femur is eleven inches." The remarkable feature of this specimen is, that while the shape of the femur is retained, the bone has passed into a soft condition, so that it might readily be twisted into a knot. On examining sections of it we find throughout the greater part of the shaft that the medulla has disappeared, the whole of the osseous structure between the central canal and the periosteum has softened down, and its place is occupied by a fatty material resembling adipocere.

We can, however, form only an imperfect notion of the pathology of the disease until we examine sections through the extremities of the femur which are still comparatively healthy; here we find the articular cartilages in places unaffected, and ossification is progressing in a very perfect and orderly manner, but the cancellated tissue a short distance from the cartilage is filled with round cells; in other places composed of a fine fibro-cellular material similar to that of cartilage when it has undergone fibroid degeneration and then broken down into a cavity or ulcer. In some sections we see the cells of the articular cartilage undergoing very peculiar changes, each of the original cells breaking up into a nest of cells which individually resemble the blood globules of a fœtus. In fact, it seems as though the early stage of the disease existing in these specimens was nearly related to the condition noticed in cases of lympho-sarcoma: the cells of the medulla, from some obscure cause which we do not understand, have failed to perform their normal functions, their tendency under the circumstances being to revert to their cartilaginous prototype, as though there were something defective in the living matter of the blood. Presuming that the round cells of the medulla are organisms the outcome of the cartilage and blood cells, in the case we are considering, the living matters of the blood being defective, the inherited tendencies of the cartilage cells predominate, and so the medulla in place of building up new bone to replace that which disappears in the ordinary course of disintegration, breaks up into a lowly organized fibroid structure and subsequently degenerates into a fatty substance such as that which we see filling the cancellated structure of this femur.

We can understand why this bone has been converted into a soft structure, for none of the cells are present which ordinarily reproduce the osseous tissue, and so the femur has been converted into this pliable mass; in places its trabeculæ contain a system of perfectly formed lacunæ surrounded by layers of soft fibroid structure, and the spaces encased by degenerated bone of this description are occupied with a crystallizable fatty substance. We can equally well, however, comprehend how it happens that, when softening of the bones has taken place, if the progress of the disease is stayed before actual degeneration of the whole of the medulla has occurred, that the round cells left in it might again perform their functions and produce normal osseous tissue.

It is unnecessary for me to occupy your time with minute details regarding the changes in the bone observed under the microscope in cases of mollities-ossium, or to give you particulars of chemical analyses of bones affected with this form of disease. Not that I overlook the great importance of accurate researches of the kind, but so far as I know they have not added anything definite to our knowledge on this subject, and are hardly likely to do so unless the specimens examined are taken—in the first place, from bones affected by the same form of disease; and, secondly, from corresponding portions of the diseased bones.

I have a specimen here in which softening of the bones had occurred during life. The patient died from widely disseminated carcinoma. These ribs, for instance, can be bent and twisted like cartilage, they are not much altered in external appearance, but in comparing sections of these bones when dry with corresponding portions of a healthy rib we see how great a loss of osseous structure has occurred in the diseased specimen. In the bone soon after death we found that the whole of the open cancellated tissue was filled by a carcinomatous growth which had entirely replaced the medulla, and so brought about changes in the ribs similar to those I described to you as existing in the femur, in the one case the soft condition of the bone being due to a sarcomatous, fibroid, and fatty degeneration of the medulla, in the other to its destruction by a carcinomatous formation, illustrating the fact that softening of the bones during adult life may occur under various circumstances. But there is a class of cases in which no suspicion whatever exists as to the presence of malignant disease, but in which one or more of the bones gradually become soft, yielding to external pressure or to muscular action, and so leading to deformity of the parts affected; the diseased bones may ultimately recover their hardness, and so the mal-position they have assumed become permanent. In too many cases, however, the tendency of the abnormal action is to involve one bone after another, until the spine and ribs become so much distorted that the action of the heart and lungs is interfered with, and the patient dies from pressure on parts essential to life, but not from disease of the viscera, which have in many cases of osteo-malacia, been found healthy after death.

During the early stages of the malady above referred to, the patient usually complains of deep-seated pain, not unfrequently referable to the lower part of the spine, pelvis, or loins; the pain is increased by moving, or by pressure applied over the part, and is hardly to be distinguished from that of muscular rheumatism, but it is usually accompanied with extreme lassitude, and sometimes with an uncertain feeble gait and continued fear of falling, without any loss of sensation in the lower extremities, or symptoms indicating softening or abnormal change in the spinal cord.

The characteristic features of osteo-malacia are associated, however, with the softening of the bones. Diminution of stature, deformity of the spine or pelvis, fracture or destruction of some of the long bones has been noticed to occur in different order of priority in various instances of the disease. Symptoms of this description may increase, until all the bones of the skeleton are reduced to the condition in which you see this femur, or the malady may be arrested in any stage of its progress, as is evident from the observations of De Cosati, of Milan, where osteo-malacia is more frequently met with than in this country; in fact, De Cosati treated no less than sixty-two patients in the course of eighteen years suffering from deformities of the pelvis produced by this disease. Mr. Durham has collected the records of 145 cases of mollities-ossium, and of these no less than 133 were affected with disease of the bones of the pelvis, so as to interfere with the process of natural labour.

All the instances of osteo-malacia treated by De Cosati occurred among women, the disease commencing during, or shortly after, pregnancy, and this statement agrees with Mr. Durham's figures, for out of his 145 cases, 132 were females, and of these 91 were affected by mollities-ossium during pregnancy or shortly after child-birth, the majority of the patients being from 25 to 35 years of age.

These figures strengthen the idea that osteo-malacia is far more frequent among women than men, and that it occurs in the greater number of cases in connection with pregnancy. It is further probable that in many cases the conditions under which the patient lived had much to do with the development of the disease. In De Cosati's practice all his patients suffering from osteo-malacia resided in the Valley of Olna, the district in which pellagia and typhus were most common. All the women came from wretched villages, where food was scarce, consisting for the most part of maize or rice, often musty. They worked in close badly ventilated rooms. Added to these unhappy conditions, De Cosati supposes that the character of the water and vegetables with which the people eke out their scanty diet is largely concerned in the production of the disease.

I think we are justified in concluding that cases of mollities-ossium may be divided into three classes:—

Firstly,—Those due to carcinomatous or sarcomatous disease of the medulla.

Secondly,—Those due to an affection of the medulla allied to lymphoma.

Thirdly,—Those due to some peculiar condition of the medulla, or perhaps of the blood, dependent on the state of pregnancy.

It would be simply guess-work in the present state of our knowledge to speculate on the pathology of the latter form of the disease; but it is satisfactory to know that this condition is amenable to treatment. While endeavouring to alter the hygienic circumstances under which the affection occurred, we may with advantage order the hypophosphate of lime, ferric oxide, and cod-liver oil. Drugs of this description, together with good diet, have unquestionably proved serviceable in the treatment of osteo-malacia occurring during pregnancy; but, I need hardly remark, if arising from either the first or second causes above specified, we know of no remedies likely to improve the patients' condition.

BRITTLE BONES.

You are probably aware that on examining the bodies of insane patients, their ribs have occassionally been found extensively fractured. It has been alleged, on the one hand, that these injuries were the result of ill-treatment on the part of the attendants or other persons entrusted with the care of the patient; on the other hand, it is asserted that fracture of the ribs was no evidence whatever of rough or improper treatment, because persons affected with mental disease are subject to a peculiar affection of the bones, especially of their ribs, rendering them so brittle that they break when an amount of force, which would be harmless in the instance of sane persons, is applied to them. This latter idea has been insisted on by some practitioners engaged in the treatment of lunatics, and their views have been supported by surgeons of eminence. On referring to some of the published reports bearing on this question, I find observations such as the following:—in one case after death "the sternum broke across during removal, the cancellated structure at the seat of the fracture was partly absorbed, leaving a cavity which contained unhealthy pus." Again: "while removing the sternum it broke across, between the second and third ribs. The compact structure forming its surface was very thin and brittle; the cancellated portion, soft, spongy, and easily crumbled between the fingers; while part of it was broken up and mixed with sanguineous pus"; the ribs are mentioned as being "soft, greatly deficient in inorganic matter, easily bent at a right angle," and so on.

You will probably agree with me, that observations of this description are hardly sufficient to convince you that the ribs of insane patients are at times diseased to such an extent as to render them extremely brittle, and, therefore, very easily fractured; in fact to arrive at any definite conclusion on the subject is a matter of great labour and care, only to be carried out satisfactorily by pathologists who have become thoroughly acquainted with the minute anatomy of the osseous system in a condition of health, as well as when affected by disease.

I commenced my researches into the state of the ribs of insane patients, fully expecting to meet with some interesting pathological changes in the bones, but I have been disappointed, for as I worked on at specimens of this kind, I gradually arrived at the conclusion which I now hold, that neither the ribs nor other bones of insane patients are subject to any peculiar abnormal changes which render them more brittle than the bones of other people of the same age, and this remark applies to the ribs of two insane patients found to be fractured after death. In one of these my results were confirmed by a chemical analysis of a portion of the broken bone close to the site of fracture.

I admit that insane persons, like other people, differ individually as to the time of life when they become old: a lunatic may be structurally as aged at fifty as another man is at sixty, and under these circumstances his bones will be brittle when he is comparatively young in years; but this fact in no way favours the idea that insane persons are liable to an affection of the ribs, such as has been referred to above.

It seems to me more probable that when several of the ribs are found to be fractured during life or after death in the case of lunatics, in all probability the injury has been caused by the attendant's kneeling on the patients' chest to keep them from moving, and that the ribs have resisted the extra pressure so long as the lungs were inflated with air, but directly they became empty the thorax has been crushed inwards, an accident just as likely to happen under the circumstances to a person in sound health as to one in an insane condition. As the matter now stands, if called on to give an opinion regarding a case of this kind, you can but affirm that you are unacquainted with any affection of the bones of the insane rendering them peculiarly liable to be fractured.

We know that the bones of some bed-ridden patients whether suffering from mental or other diseases sometimes become so brittle as to break even by muscular effort, and that on examination the osseous structure is found to be atrophied in consequence of its having been imperfectly nourished, and hardly ever employed on the purposes for which it was chiefly constructed, but it is surprising in cases of this description how well the brittle bones sometimes unite after having been fractured. It appears that the osseous-forming elements not only exist in some instances of the kind, but they respond at once if called upon to act, even by the irritation produced in the part through an injury.

In connection with this subject, I may now proceed to make some remarks on the senile changes occurring in the osseous system of old, though apparently otherwise healthy people, by means of which their bones are apt to become fragile, a fall or slight injury fracturing them, as we not uncommonly witness in the case of the neck of the femur. In fact, as I before remarked, we are seldom without cases of the kind in the wards of the hospital. The following is an instance in point :—

Mrs. P., æt. sixty-nine, has always been a healthy hard-working woman; on the morning of the 27th of June she went to her employment as usual, but suffering from the excessive heat, she fainted and fell on the stone floor; on becoming conscious she was unable to rise, and when taken to the hospital, Mr. F. Poynder, our house-surgeon, discovered that the patient had lost all power over her left leg. She was suffering from great pain along the outer side of the thigh and in the region of the hip-joint; on getting her into bed and laying her flat on her back, he found the left foot was slightly everted and the injured limb almost half an inch shorter than the sound one. On making extension from the leg this shortening could not readily be overcome; although the attempt caused the patient much pain, there was no difficulty in flexing the thigh, or in rotating the femur either outwards or inwards; in doing so the trochanter moved with the head of the bone. Under these circumstances our house-surgeon very properly ordered a sand-bag to be laid along the outside of the limb, and the patient was directed to remain in bed. The condition of her heart and kidneys were examined and found to be healthy. She was a spare, by no means an old-looking person for her years. I saw Mrs. P. the following day, and having satisfied myself that the above report was accurate, came to the conclusion that this was a case of intra-capsular and impacted fracture of the neck of the femur, and my prognosis was, that although we could not expect to overcome the shortening and malposition of the limb, nevertheless we might fairly hope, in the course of some four months' time, to see the patient moving about again with the aid of a high-heeled shoe and a walking-stick.

We have now to consider the data upon which this opinion was founded; in the first place, as the patient lies in bed with her legs parallel to one another, it seems hardly possible to believe that the amount of shortening of the injured limb does not exceed half an inch. In measuring the leg under these circumstances, we should take the distances between the anterior superior spinous process of the ilium and the outer part of the greater trochanter of the femur, comparing this measurement with that of the sound side, and verifying the result by taking the distance between the spinous process of the ilium and the outer malleolus of the ankle-joint, presuming of course that the patient is resting flat on her back with her legs parallel to one another.

There can be no doubt that in the present instance, and in fact in by far the majority of these cases, the ends of the fractured bones are driven and impacted into one another at the time of the accident; and under these circumstances the shortening of the limb is equal to the distance to which the bones have been jammed into one another.

If the surgeon, however, under the mistaken notion of restoring the limb to its original length, makes forcible extension from the leg and foot, and drags the impacted ends of the bones asunder, then the lower fragment is, on the extending force being relaxed, apt to be drawn upwards by muscular contraction, and the shortening of the limb becomes perhaps two inches. Of course in instances of intra-capsular fractures where there has been no impaction, the shortening of the limb may likewise be about two inches, but in these instances the head of the bone does not move with the trochanter on rotating the thigh, and on making, and keeping up moderate extension (the patient being under the influence of ether), rotation of the limb generally affords a feeling of crepitation near the joint.

In this case the foot is slightly everted ; this is the direction most commonly assumed by the limb after fracture of the neck of the femur, although it may be in a straight or even an *in*verted position if the impacted ends of the bone happen to fix it in either of these directions. If after an accident we find extensive ecchymosis of the skin over the upper part of the thigh, and there is loss of power over the limb and pain in the region of the hip-joint when the leg is moved, if there is a slight degree of shortening and eversion of the foot, but on extension and rotation of the limb no crepitation can be felt in or near the hip-joint, while the trochanter major moves with the head of the bone, and the latter rotates in the acetabulum with ease when the patient is placed under the influence of ether, we may reasonably conclude that an impacted fracture of the neck of the femur exists.

I have here the head and neck of the thigh-bone taken from the body of a man who died about a year and a half after an intra-capsular fracture. In this case you observe that ligamentous union has taken place between the head of the bone and the trochanter major, the neck of the femur has entirely disappeared, and in its place we find a firm fibrous structure ; in fact, we might almost imagine that the neck of the bone had been macerated in acid until its earthy matter had been dissolved out, leaving its organic substance unaffected. If we carefully examine this fibrous material we shall discover that it differs but little from the growth which usually occurs between the ends of a recently fractured bone, and which under favourable conditions becomes ossified, uniting the fragments together. Under ordinary circumstances active hyperæmia occurs in the injured parts, and the round cells of the periosteum form a thin case of osseous tissue round the end of the fractured bone, which lasts at any rate until the work of consolidation between the extremities of the bone has been effected. But the ossification of the soft structures which grow from the medullary spaces of the broken bone is a protracted process, and the tissues concerned are so delicate that unless they are protected from injury by means of artificial splints, or by provisional callus, they seldom unite at all.

Under the most favourable conditions permanent union between the ends of the shaft of a fractured femur will not be completed until five or six months. The tissue from which the shaft of a long bone is repaired, after a fracture, are unquestionably the round cells contained in the medulla, the soft structures from one end of the fractured bone uniting with those of the other end ; the result is not simply a dense, hard, cicatricial tissue, but new bone, so that in the course of years it would be impossible in the section through the part to determine where the original line of fracture had occurred.

If we apply these facts to the case now before us, it enables us to understand the principles upon which our treatment and prognosis are founded. I hardly think the non-union between the ends of the bone in instances of intra-capsular fracture of the neck of the femur is most frequently due to the insufficient blood-supply of the head of the bone, otherwise we should more frequently meet with examples after fractures of the kind in which the head of the bone had been absorbed ; but, as you will see in the specimen I now show you, the cancellated tissue of the head of the femur is supplied with blood through vessels passing along the round ligament, and through the fibrous structure, uniting it with the trochanter major. No doubt it may be a consoling idea to a surgeon in charge of a case of the kind, if he persuade himself that should union not take place between the ends of the fractured bone he is absolved from blame, because the anatomical arrangement of the parts rendered it almost impossible that union should occur. I admit that there is some truth, however, in this notion, and fractures of the neck of the femur happen most commonly among persons whose bones are brittle; that is, they have undergone senile degeneration, the bone-cells, probably from inadequate vital power, secrete an imperfect hyaline material, and the space in which the bone-earth has to be deposited being diminished, the strength of the bone is lessened, in other words, it becomes brittle in patients affected in this way. The reparative process is uncertain; they are, as I have before remarked, old in structure though perhaps not in years.

But fractures of the neck of the femur are usually impacted, and this means that the delicate cancellated tissue in the ends of the broken bone are jammed into one another, and unless you have examined specimens of the kind carefully you can hardly understand the amount of damage which is inflicted on the medullary and trabecular structures by this accident, so that in addition to the lengthened period necessary for the reparation of an ordinary fracture, time must be allowed for the reconstruction of the smashed cancellated tissues.

Then, again, there is here a peculiar modification of the periosteum, its deeper layers alone intervening between the bone and synovial membrane, so that the blood supply necessary to form active medulla is limited within the capsule to vessels reaching the cancellated tissue through the round ligament and from the bone beyond its neck. But surely this makes it all the more necessary for the surgeon to afford artificial aid, endeavouring to keep the ends of the fractured bone in apposition rather than trying to console himself with the notion that the case is beyond his power in consequence of the defective blood supply to the part.

There can be no question as to the fact that no class of cases requires greater care and patience to be exercised both by the surgeon and his patient than those of fracture of the neck of the femur. If you really believe, that Sir A. Cooper was correct in his advice not to keep a patient confined to his bed after an accident of this description beyond a week or ten days, and that you must allow him to sit up and move about on crutches as soon as he feels that he can do so without pain, then of course there is an end of the matter, for it stands to reason that whether the fracture be an impacted one or not, the weight of the leg must inevitably move the lower fragment and effectually prevent the delicate medullary tissue from forming new bone.

But it is evident that the ends of the bone in a fractured neck of the femur will unite under certain circumstances, and it is impossible to tell how far the influence of Sir A. Cooper's teaching has been the indirect cause of the number of instances of un-united fractures of this kind which we meet with in practice. No doubt, as I before remarked, the reparative processes under these circumstances are slow, because the vital powers of the patient are at a low point; but that is all the more reason why we should persistently exercise our surgical skill, rather than excuse ourselves for standing with folded hands and doing nothing.

In the specimen before us, at first sight we might conclude that the only structure connecting the head to the shaft of the bone is a dense fibrous tissue; but on closer examination you perceive that there are several spurs of bone passing from the cancellated tissues of the head of the bone towards the trochanter major. You will find processes of a similar nature in most of the preparations existing in our museums, and there is no reason at all why the structure surrounding this process of bone should not also have produced osseous tissue: in fact, it is not the bone-forming power of the part that is always at fault, but it is often the circumstances under which these delicate structures have been left by nature and the surgeon, which have effectually prevented the growth of the necessary bone to repair the fracture. I believe, if you can keep the parts at rest, in many cases of intra-capsular fracture union of the ends of the bone will occur.

I need hardly remind you that in instances of fracture of the neck of the femur it is necessary before venturing on a prognosis carefully to examine the condition of the patient's heart and kidneys, for in chronic affections of these organs œdema and consolidation of the lungs is apt to occur, and this danger is increased if a person suffering from disease of the kind is laid on his back in bed for any considerable length of time.

I admit also that non-union is more common after these fractures than in similar injuries to other bones, and I have given reasons why such should be the case; but then I hold most firmly that it is your duty to do all in your power to procure union between the ends of the fractured bone. We may fail, and so great may have been the injury done to the medullary tissue that although the impacted bones hold together mechanically for a time, ultimately absorption of the injured structure takes place, and so what appeared at first to be a fortunate case turns out a disastrous one. But if the surgeon has confidence in himself he will impart the same feeling to his patient; and the facts of the case being explained, no reasonable creature would fail to choose the wiser part and give himself the opportunity of being cured. With this object in view our patient in Queen Anne's ward remained in bed for two months from the time of the accident; she was then permitted to lie outside the bed, but on no account to put her foot to the ground for another month; and the result has been, as Mr. Poynder reports, that she left the hospital with only slight shortening of the limb and eversion of the foot; but was able to move about with perfect freedom aided by a walking-stick. This is the second case of the kind I have seen within the past few months.

You may exclaim against a system of treatment involving three or four months' confinement, but surely that is better than the entire loss of power in the limb for life, if it affords a reasonable hope of doing good. At any rate your line of action is clear enough—to insist upon that which is best calculated to lead to the recovery of your patient, and if your advice is refused, to clear yourself from further responsibility. Provided your patient is free from organic disease, and has not been roughly handled in the first place, and thus had the impacted ends of the broken bone drawn asunder, you may reasonably commence the treatment of the case under the impression that union of the fractured bone is likely to occur, and that your patient runs no great risk of bed-sores or hypostatic consolidation of the lung. Much may be done towards warding off this latter complication by having the patient placed on a bed constructed so that his body may be raised into the semi-erect position without throwing much weight or movement on the injured hip.

LECTURE XI.

TUMOURS OF BONE—OSTEO-SARCOMA—ENCHONDROMA.

J. M., æt. twenty-four, was admitted into the hospital on the 27th of March. Her mother died when forty-five years of age, from some affection of the uterus. Her father is alive and well. She has brothers and sisters, some older, some younger, than herself, who are in good health. Our patient had four children, the youngest being only a month old when she came into the hospital.

J. M. stated that four years ago she felt a peculiar numbness over the right shoulder; after a time the part became painful, and she then noticed that there was a swelling over the region of the scapula, which had gradually increased in size, causing her great pain. She was consequently sent into the hospital by Mr. F. W. Butler of Brighton.

On admission a tumour about the size of an infant's head was found occupying the region of the right scapula. It projected forwards through the axilla, beneath the pectoral muscles; it also passed under the outer part of the clavicle. The tumour surrounded a considerable part of the shoulder, but the joint was not implicated in the disease. I thought I could detect the subclavian artery above the upper edge of the tumour, but the circulation through this vessel was impeded, for there was only a feeble pulsation in the brachial artery. The right hand and arm were œdematous.

The skin was not adherent to the tumour, and was apparently healthy except in one or two patches, where it was red and inflamed; beneath these spots fluctuation could be felt, otherwise the whole mass of the morbid growth felt firm and hard, it was moveable on the surrounding structures, no dilated veins could be seen coursing over it. There were no enlarged cervical or other lymphatic glands in the neighbourhood of the morbid growth. Our patient suffered from excruciating pain in the tumour, right side of the neck, and arm, which we could not relieve by morphia, chloral, or any other drugs. She urged me to take away the tumour at any risk.

J. M.'s child having been weaned, and her general health improved as far as possible, I proceeded to excise the scapula, together with the outer half of the clavicle and the right arm. I determined in the first place to tie the subclavian artery, and having to take away the outer half of the clavicle, I commenced the operation by removing about an inch from the central part of the bone. Having done this, I found a portion of the tumour passing upwards behind the scalenus muscle. I was unable to discover the artery, and it was impossible to waste time in searching for it, running the risk of wounding one of the large veins at this stage of the operation, so that I made the necessary incisions through the skin over the tumour, and, having separated it from the surrounding tissues, it was turned forwards together with the arm over the chest, and was then readily severed from the body. In spite of the able assistance I received, the hæmorrhage during the last stage of the operation was great. The patient died on the following day.

There can, I think, be no question as to the desirability of dividing the clavicle in the first stage of an operation for the removal of the scapula and arm, and it is evident if the subclavian artery can then be secured, the risk of severe hæmorrhage is diminished. But in the living subject, and supposing the vessel is in its normal position, it is by no means always easy to put a ligature round this artery, and if its relations to the surrounding parts are distorted by a morbid growth such as we had to deal with in this case, the difficulty of securing the subclavian in the third part of its course is much enhanced. We should always therefore be prepared under these circumstances to abandon the attempt; it is impossible to waste time in searching for the vessel, the patient necessarily losing blood while we are doing so, and we must proceed at once to separate the tumour from its surroundings, and, thrusting it and the arm forwards, pass a ligature if possible round the subclavian, or, having the vessel securely grasped by an assistant, divide it the last thing before completing the separation of the parts from the body.

The question has been raised as to the propriety of taking away the scapula, arm, and half the clavicle, but I have the published records of thirteen cases of the kind, and in eleven of them the patient lived for upwards of six months after the operation; in two, death occurred directly from hæmorrhage or shock; so that, provided the case under our notice was a proper one to operate on, it was evident the removal of these parts was a measure warranted by previous surgical experience. I believe also that, if any operation was to be performed, nothing less than the removal of the parts I have above mentioned was justifiable; for if we had attempted to preserve the arm, it was more than probable some of the morbid growth would have been left behind attached to the structures surrounding the upper end of the humerus, and so the disease would have reappeared in the wound. And, further, I was convinced, from the patient's condition, worn out as she was with pain, that it was needful to expedite the operation as much as practicable, and while excising the tumour we should be unable to afford the time to make an elaborate dissection of the morbid growth in the axilla, supposing we could even have done so without dividing some of the large vessels and nerves supplying the limb.

While considering the circumstances of the abscission of this tumour, we necessarily had to determine the nature of the morbid growth, and the probabilities of its recurrence after removal. In this case there was no enlargement of the lymphatic glands, so far as we could ascertain; the tumour was movable on the ribs, and was evidently isolated in a great measure from the tissue among which it grew; the skin was not adherent to the tumour, nor were there any enlarged veins coursing over its surface; the patient's eye and complexion were remarkably clear; she had rather the appearance of a person suffering from hectic than the dull jaundiced hue of advanced cancerous cachexia; consequently, although the tumour had of late grown rapidly, and caused the patient intense pain, nevertheless, from the symptoms, and appearances it presented under the microscope (of a portion of the tumour removed by means of a grooved needle), I had no doubt as to the growth being an osteo-sarcoma.

I shall subsequently endeavour to explain the etiology of these tumours, and you will then understand how it is that they are liable to appear in various parts of the body. Consequently it was impossible for us to determine in this case, if after the removal of the growth others of a similar kind would not appear in different parts of the body; but from my own experience, and that of other surgeons, I could most distinctly affirm that large osteo-sarcomatous tumours such as this was have been removed, and the patient remained free from the disease for many years, if not for life.

Had the lymphatic glands been enlarged, or had there been evidence that the morbid process had infected the surrounding structures, and been not only a rapidly growing but a very vascular growth, then our prognosis would have been unfavourable, for we should probably have had to deal with a malignant tumour, and not with an osteo-sarcoma.

After removing the morbid growth, we were able to inject a small part of it through the subclavian artery, which we found imbedded in the tumour.

On cutting into the tumour, we discovered that the bone from which it had originally grown had almost disappeared; the head, neck, acromion process, and a part of the spine, all of which were covered with periosteum, were the only portions of the scapula which remained. The bulk of the morbid growth was composed of a fibro-cellular mass which in parts was dense, almost like cartilage, but which had in places softened and broken down into cavities of an irregular shape. Scattered throughout the tumour were a number of spiculæ of bone.

However carefully we might examine sections cut from the bulk of this tumour, we should, I think, gain an imperfect idea as to its nature;

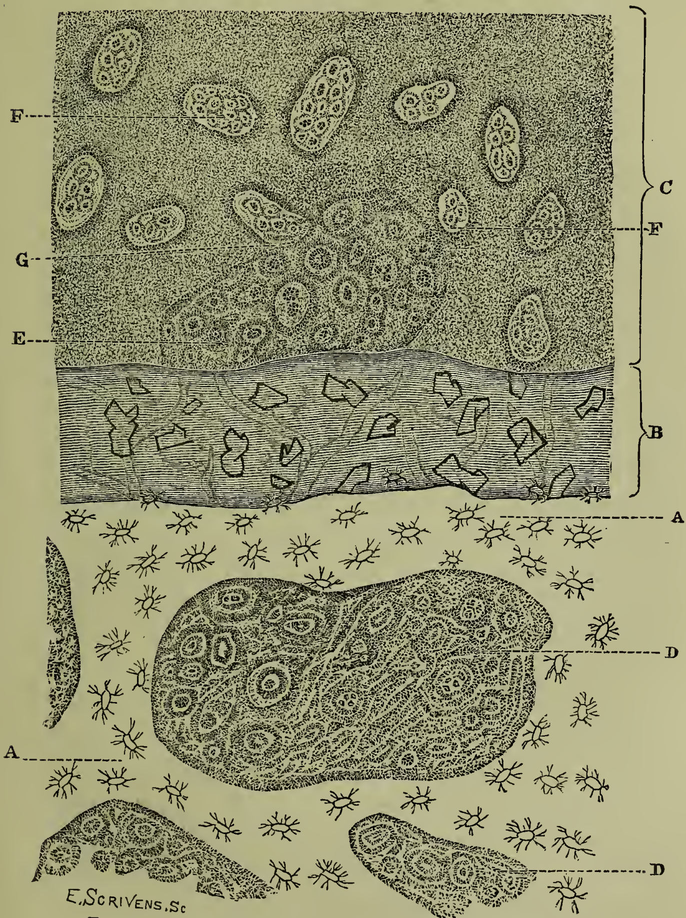

FIG. 5.—Section through articular cartilage and subjacent bone in a case of osteo-sarcoma.

The bracket C delineates the thickness of the articular cartilage.

The bracket B shows the hard lamina of bone separating the cartilage from the fully formed bone.

A A, Bone corpuscles.

D D, Cancellated spaces in the bone, the medulla they contained having been converted into a sarcoma.

E, Cartilage cells undergoing transformation into sarcoma.

F, Isolated cartilage cells undergoing changes into the compound (myeloid) cells of osteo-sarcoma.

but you will observe, as is commonly the case in osteo-sarcoma, the morbid action appears to have stopped short at the dense lamina of bone which separates the cancellated tissue with its medullary contents from the articular cartilage. We find the spaces of the trabeculæ in the head and neck of the bone occupied by a sarcomatous formation. This condition of things extends up to the lamina of bone to which the articular cartilage of the glenoid cavity is attached (Fig. 5). To the naked eye this latter structure appears to be white, glistening, and healthy, but if we examine sections of it under a quarter of an inch glass, we discover that its cells are undergoing a peculiar transformation. The nuclei of these cartilage cells have, in fact, undergone a process of proliferation, the contents of the original cell having divided into eight or more portions. Each of these subdivisions of the nucleus is surrounded by an area of soft granular matter constituting a cell, and these cells lie in a coarse granular material, so that each of the original cartilage cells is changed into a giant cell (myeloid). In many places we see the commencement of this process, in others the giant cells have amalgamated and formed a patch of round-celled sarcoma, and I would have you particularly notice that the hyaline structure surrounding these cells is perfectly healthy; it contains neither vessels nor any trace whatever of disease.

You are aware that authorities on the subject hold that sarcoma commences "from connective tissue, as these are always vascular" (E. Wagner); but we have here a striking illustration of the fact that sarcoma may appear in non-vascular structure by the transformation of its cells into an abnormal form. We see the nuclei of the cartilage cells subdividing and growing into the cells characteristic of sarcoma. The abnormal change seems to be simply one of perverted growth taking place without the intervention of any foreign element or visible external agencies.

I think it requires no great stretch of the imagination to conceive the idea that the contents of these cartilage cells had acquired an inherited fault which at a certain period of its life manifested itself in the ill-conditioned growth we call sarcoma.

If the cell-contents of cartilage undergoes changes such as those I have described, it is reasonable to suppose the round cells of the medulla of bone, which are the direct descendants of temporary cartilage cells, might be affected in the same way. I have before explained to you that it seemed to me that the round cells of the medulla result from the fertilisation of the temporary cartilage cell by the white blood-corpuscle, and that this compound cell inherits the properties of its progenitors, on the one hand being capable of forming bone, and on the other fibroid tissue. We can understand therefore how it happens that, while this morbid growth has destroyed the scapula, there is a considerable quantity of new bone formed throughout its substance.

For instance, on examining sections through the neck of the scapula, we see its cancellated tissue full of sarcoma (Fig. 5), and as the integrity of the trabeculæ depends on the health of the medulla, so when this latter structure becomes diseased the bone rots away. On the other hand, bone has formed in irregular patches throughout the bulk of the tumour, because the cells constituting the morbid growth have a tendency to revert to their normal functions and form bone; they are incapable of doing so in proportion as their perverted or diseased properties preponderate over their healthy action; and so some of these osteo-sarcomas contain a complete skeleton of bone, others large and irregular patches of it, and some are pure sarcoma, although originating in the medulla of bone.

These tumours have frequently been described as cartilaginous or fibro-cellular, myeloid, and so on; but when examined under the microscope they contain "a dimly granulate stroma, closely resembling the material of cartilage, but containing no true cartilage cells," because, as I have explained, the tumour originated in a perverted growth of the round cells of the medulla, which, being the descendants of cartilage cells, tend to the formation of a modified form of cartilage, fibroid tissue, or of bone, in their irregular growth.

The myeloid tumours have generally been described as attacking the articular ends of bone; or, beginning in the centre of the bone, they gradually expand it, forming a globular osseous shell—the spina ventosa of older authors. Mr. Bryant describes the interior of this shell as being made up of fibre tissue, or it may be cystic, the cavity being divided up by means of fibrous septa, the cells containing "an opaque white, intermixed with a semi-transparent gelatinous-looking substance of a cherry red colour, made up of poly-nucleated and irregular myeloid cells," these cells being, as I have explained, modified cartilage cells.

These myeloid tumours of bone are sometimes very vascular and pulsate distinctly, and so have not unfrequently been described as pulsating tumours or aneurisms of bone. The following case, taken from Mr. Stanley's work on diseases of bone, illustrates this fact:—

An old man, in the course of two years, had seven pulsating tumours developed in different parts of the skeleton. He died comatose. The body was examined, in the presence of Scarpa, by Dr. Borta. The arterial system having been injected from the aorta, the tumours were then examined. Each tumour was invested by the periosteum, which was thick, spongy, and very vascular. Beneath it was a reddish-yellow mass, soft in some parts, elastic in others, traversed by a net-work of arterial capillaries. All the tumours presented the same structure. A case, still more remarkable, is recorded by Cruveilhier, in which numerous tumours formed in various parts of the body, all strongly pulsating, and presenting, besides, a distinct *bruit de soufflet.* Upon examination some of these tumours were found to have originated in the bones; but there were others wholly unconnected with them. All the tumours presented the same structure, being composed of cells of various sizes, divided by fibrous threads, and filled with blood.

In practice we find that the osteo-sarcomatous tumours often grow in, and not unfrequently expand, the cancellated extremities of the long bones, probably because the round cells of the medulla are most plentiful in this locality. These morbid growths may also spring from the periosteum, and this structure, again, contains a great number of the round cells derived from the same source as those found in the medulla, and liable therefore to take on a similar abnormal action.

If we keep these ideas regarding the nature of these osteo-sarcomas steadily in view, it is by no means difficult to comprehend how it sometimes happens that they contain bone, cartilage, or fibro-cellular structures in various forms and modifications, these being accidental, attending the perverted growth of the medulla. We may also perhaps thus comprehend the clinical history of osteo-sarcoma; for the elements of which these tumours are composed vary according to the inherited tendencies of its cells, or of their surroundings, but it is still the outcome of an altered growth in the medulla, and therefore no more infective to other structures than a bone is; and this leads to another practical consideration with reference to this part of our subject.

Osteo-sarcomas, as a rule, do not spread from one part of the body to another by infection or propagation; but the disease, originating from a faulty condition of the fixed cells in certain elementary structures, is co-extensive with the number of cells in the body capable of originating this peculiar transformation. The affection may therefore be local or general. It is utterly impossible for us beforehand to form a prognosis on this point. We can, however, assert that, as a rule, there is infinitely more likelihood of a sarcoma which has grown slowly being localised to the spot in which it has formed than one which has grown rapidly.

For instance, here is a cast of an osteo-sarcoma kindly taken by Dr. Walker, our dental surgeon, from a patient of mine. When about three years of age a tumour, the size of a pigeon's egg, was removed from the alveolar process of his right superior maxilla. About nine years after the operation the morbid growth had re-formed; it was then excised, together with a portion of the bone from which it grew. But now, after a period of eight years more, we see from this cast the tumour is of considerable size. It has moulded itself to the arch of the palate, and causes the patient but little inconvenience, and so I recommended that for the present it should be left alone; but this is an instance of a slowly growing sarcoma, springing doubtless from the medulla of the upper jaw; in fact, the upper and lower maxillary bones seem to be peculiarly liable to originate osteo-sarcomatous growths, and we find descriptions of them in most surgical works under the heading of "Cartilaginous or Fibro-cellular Tumours of the Jaw." Some of these reach a considerable size before they are removed.

One of the most successful operators in cases of this description was my predecessor in Calcutta, Mr. R. O'Shaughnessy. The museum in that city contains some of the finest existing specimens of these osseous tumours.

I had a characteristic case of epulis sent me only a few days since. The patient was forty-five years of age, and had a hard tumour about the size of a cob-nut growing from the alveolar edge of the lower jaw behind the left canine and bicuspid teeth, which teeth it had thrust somewhat forwards. It gave the patient no inconvenience whatever, and during the past seven years has not increased in size. The tumour had been removed once when the patient was a lad, and again ten years ago. The last time, he says, it was tied, and allowed to slough away; but it was very evident the only means of cure in a case of the kind was to extract some of the teeth, and excise the epulis with a portion of the bone from which it originated, a proceeding perfectly justifiable and correct if the tumour had been increasing in size, or causing the patient inconvenience. However, under existing circumstances, I could confidently assure this man that were I in his position I should decline having my jaw cut into; and as these views were quite in accordance with his own ideas of the matter, it was agreed that the growth should be left alone unless it either increased in size, or caused the patient pain or inconvenience at some future time.

Dr. Grigg sent us lately, from the out-patient department, an instance of osteo-sarcoma of considerable interest, especially when its details are contrasted with those of the first case referred to in this lecture, which illustrated the circumstances of an osteo-sarcoma of rapid growth having been less than four years in existence. Dr. Grigg's patient had suffered from an osseous tumour of the same description, originating from the upper part of the humerus, for no less than twelve years without experiencing inconvenience beyond that produced by its bulk.

Mr. G. Butler reports, concerning this case, that Jane L., æt. fifty-six, first noticed a lump forming on the upper and outer part of "her shoulder" some twelve years ago. She does not remember receiving any injury to the part. The swelling gradually increased in size, causing the patient no great pain or inconvenience beyond that produced by its bulk,

On admission, I found the patient to be a healthy, active person for her age. A large tumour occupied "the back of her shoulder, extending half-way down her arm"; its circumference measured 22 inches. The tumour was clearly growing from the humerus, forming, in fact, a part of that bone; it felt like a large cartilaginous mass, with here and there spots of softened tissue in its substance; over these red patches the skin was red and tender, but not ulcerated, and the integument covering the remainder of the morbid growth was normal in appearance. There were no enlarged lymphatic glands in the neck.

We had in this instance a case of osteo-sarcoma to deal with, and our advice to the patient was in favour of leaving the tumour alone, for it was simply an inconvenience to her. It caused no pain, its growth had been a matter of twelve years, and considering that the patient was fifty-six years of age, we were evidently not justified, under existing circumstances, in proposing so serious an operation, as the removal of the tumour would have been to a person at her time of life, especially as she ran, practically, no risk of the morbid growth infecting the system.

I do not think even rapidly growing and vascular sarcomas (generally myeloid) are usually disseminated by means of the blood to the lungs and other organs; still it would be foolish to deny the possibility of the disease spreading in this way, especially as we know how freely the open venous sinuses of the medulla of bone take up pus and other such materials, forming, in fact, a channel through which organic particles can pass to any part of the body, and so broken-down or softening sarcoma may be carried by the circulating fluid to distant organs. Yet I have known so many instances where nothing of the kind has occurred, that I am disposed, with the evidence at present in my possession, to hold to the ideas above inculcated.

It is obvious, therefore, that an osteo-sarcoma, unless it be a very rapidly growing one, may be regarded for surgical purposes as a local disease; but it is nevertheless right to err rather on the safe side in operating for the removal of such tumours. Thus, in osteo-sarcoma of the fore-arm or arm, if you cannot excise the morbid growth with a portion of the bone from which it grows, amputate in the one case through the elbow, in the other through the shoulder-joint.

And so in the leg, I have excised several very large osteo-sarcomas with the portion of bone from which they grew without sacrificing the limb; but if this cannot be affected, amputate through the knee-joint. On the other hand, if a tumour of the kind originated in the cancellated tissues of the lower end of the femur, considering the risk to life of amputations through the hip-joint, I should not hesitate to remove the limb close above the morbid growth, running the risk of its having spread along the medulla. On the same principle there can be no reason why you should not form your flaps in cases of the kind from the skin covering the tumour, supposing, of course, that the integument is otherwise healthy.

If the origin of osteo-sarcoma is such as I have described, we might reasonably expect to meet with instances of the disease among the lower animals; and such, in fact, is the case. Horses, and more especially white ones, are not unfrequently affected with sarcoma. Heckel has attempted from this fact to argue that all white horses originated from a common stock, and hence all are susceptible through hereditary transmission to a common form of perverted growth, acquired by one of their ancestors.

We might, if we thought proper, probably accumulate data showing that sarcoma was more frequently met with among fair-haired Europeans than in dark persons. Such is the case in a marked degree with some of the patients whose histories I have to-day brought to your notice; but then, if we turn to other parts of the world, such as India, we discover that people with black skins suffer from these diseases in as large a proportion as Europeans.

ENCHONDROMATA.

Cartilaginous tumours originating in the medulla or deeper layers of the periosteum are, from a clinical point of view, similar to the osteo-sarcoma. It is perfectly easy to comprehend this fact, when we consider the origin of many of the cells growing in these tissues. A mere preponderance in their inherited tendencies towards the development of cartilage over that of the fibro-cellular formations, will determine whether the structure of the abnormal growth principally resembles cartilage or the softer tissues of the body. I say chiefly resembles, because I have never yet seen a purely cartilaginous tumour originating in osseous structures; the enchondromata, so far as my observations go, invariably contain elements, to a greater or less extent, precisely analogous to those found in osteo-sarcoma.

On the other hand, all the enchondromatous tumours of bone I have met with have enclosed cells that were becoming ossified; or, in other words, forming bone. Sir J. Paget remarks of these tumours, that we "find cancellous tissue with marrow or medullary substance in its interspaces, and when the ossification of the tumour is complete the new cancellous tissue is usually invested with a thin compact layer, or outer wall of bone, which, if the tumour has grown on a bone, becomes continuous with the compact tissue of that bone."

These cartilaginous tumours grow very slowly, and are painless, unless involving or pressing on nerves; the skin covering them is healthy, in fact, the symptoms attending their formation exactly resemble those I have described as characteristic of slowly-growing sarcoma, but the enchondromata are more resistent to the touch. They feel as though they were composed of cartilage, with here and there soft, if not fluctuating patches in their substance, due to the breaking down of portions of the tumour into cysts. These cavities usually contain a brownish serous fluid, with softened and broken-down tissue. Some enchondromas grow to a great size; for instance, we have the records of a case in which the shaft of the femur, from the knee-joint to within an inch of the trochanters, was involved in a cartilaginous mass 3 feet in circumference. In another case, the tumour growing from the femur measured no less than $6\frac{1}{2}$ feet in its circumference. The most common site of these cartilaginous tumours is the phalanges of the fingers and toes, the humerus, femur, tibia, in the order mentioned. They are sometimes met with springing from the jaws, pelvis, and scapula, still more rarely from the ribs and basi-cranial bones. As a rule, those enchondromas which are connected with the larger bones, such as the femur, originate in the periosteum.

Most of the enchondromata make their appearance before the ossification of the bone from which they arise is completed, but as their growth is painless and often slow, it may be some years after puberty before any notice is taken of the tumours, and it seems probable that cartilaginous tumours originating from the bones of the hands or feet may, in the first instance, be simply outgrowths of the epiphysis, such as I shall describe to you in the next lecture under the head of exostosis. They are in truth defects in the formative power of the part from which they originate, and so in the hands and feet these tumours appear in childhood, several of the bones being affected, and it may be this tendency to a perverted growth extends to other parts of the skeleton, so that cases are on record in which cartilaginous tumours have formed over various parts of the body, pointing to the verification of the ideas I have already inculcated regarding the osteo-sarcoma, that they arise from inherited abnormalities of the elementary tissues of the body.

The enchondromata are non-malignant growths, but Sir James Paget has given us an instance in which there was evidence of the living cells of a degenerating cartilaginous tumour having been carried by the circulating fluid to the lungs, and there taken root and growing. Accidents of this kind must be extremely rare, nevertheless they indicate the truth of a statement I made in a former part of this lecture, that the class of tumours we have been considering may sometimes extend from the primary formation into the tissues of the body through means of the blood. This fact, however, does not in any way invalidate the rule I have laid down that tumours of this description, when from their size or other circumstances they become inconvenient to those afflicted with them, should most certainly be removed. But, as I have before remarked, there are few conditions under which I should amputate a limb for an osteo-sarcoma, or an enchondroma, before I had attempted to excise the morbid mass with a portion of bone from which it grew, unless its size precluded the possibility of the lesser operation, or the situation of the tumour, as in the instance of J. M., was such as to prevent our taking it away without sacrificing a limb at the same time.

LECTURE XII.

TUMOURS OF BONE (*continued*):—EXOSTOSIS, CYSTIC, VASCULAR, AND MALIGNANT TUMOURS OF BONE.

GENTLEMEN,—Having in my last lecture referred to osteo-sarcoma and enchondroma of bone, we have disposed of the larger class of tumours originating from osseous tissues. It would be simply impossible for me to describe all the varieties and the different histological arrangements of these morbid growths; and, from a clinical point of view, there is no necessity for doing so, for if called upon to form an opinion regarding any particular case, we must, from the history and position of the tumour, endeavour in the first place to determine from what structure it has originated, and this will give us a pretty accurate idea of the elements of which it is composed. The size and rapidity with which the tumour has formed indicates its vigour. In many cases its growth seems to be under the control of laws governing the ordinary formation of the body, in other instances the elements constituting a tumour appear to be utterly beyond these laws. Its growth is at enmity with that of the surrounding structures, its rapid invasion of the tissues among which it has formed, its terrible and never-ending hold upon the unfortunate victim subject to its influence, has gained for it the justly dreaded title of malignant disease, with which as surgeons we are but too familiar.

EXOSTOSIS.

The first case I shall bring to your notice to-day is an instance of the simplest form of osseous tumour, consisting of an outgrowth of the epiphyseal cartilage, which subsequently becomes ossified, and has therefore been correctly called an exostosis.

W. W., æt. five years, was sent up from the out-patient department, and admitted into the Luke ward on the 12th March. The child's mother was a well-to-do healthy woman, and our patient the picture of a rosy-cheeked country boy. His mother states that from the time he was a year old she noticed a small hard swelling about the size of a pea, which we found had increased to be an oval incompressible tumour, about as large as half a walnut, growing from the inner surface of the upper epiphysis of the left tibia; the soft tissue could be freely moved over it.

I kept the child in hospital for a few days, and then divided the structures over the tumour, and cutting through its base with a scalpel, separated it from the epiphysis. After applying some solid carbolic acid to the exposed surface of the cartilage, from which the tumour had been removed, the wound healed up rapidly, and the child soon left the hospital cured.

On examining sections of this tumour under the microscope we find it is limited on its free surface by a layer of periosteum, containing an abundance of cells. Within this layer of periosteum was a remarkably fine example of embryonic cartilage undergoing fibrillation; we see the hyaline material of the cartilage divided into fibres, its cells becoming spindle-shaped, but they contain the descendants of the nucleus of the cartilage cells, which, on the one hand, are capable of building up bone, on the other, of forming fibrous tissue. The cells of the inner layer of this strata of cartilage are undergoing proliferation, and producing bone in precisely the same manner as we see bone forming at the line of ossification in the epiphyseal cartilages; in fact, the periosteal layer I have described as composing the free surface of the tumour performs the same office as regards the increase in size of the exostosis as the epiphyseal cartilage does towards the growth of one of the long bones. The central portion of the base of the tumour has undergone ossification, its bone cells being extremely numerous, as we see in most specimens of freshly formed bone, produced under the influence of an abnormal supply of blood. In this instance, numerous small vascular canals pass from the periosteal vessels into the tumour; these blood spaces are surrounded by bone cells, arranged in a concentric manner, so as to form Haversian canals and systems.

It is evident, therefore, that this small tumour was an out-growth of the epiphyseal cartilage subsequently converted into bone. It is in reality a specimen of normal but wrongly directed growth. Symmetrical tumours of this kind occasionally form over the body analogous to the supernumerary fingers or toes we occasionally meet with.

Exostosis of this description can only occur among young persons before the epiphyses have ossified; they seldom increase to any considerable size. The tibia, fibula, and humerus are their most frequent site; they are occasionally found near the attachment of tendons, as, for instance, of the adducted magnus to the inner condyle of the femur. When growing in situations such as this, by the action of the muscle the exostosis is dragged as it were from its point of origin, and so becomes pedunculated, but in their mode of growth and minute anatomy these pedunculated exostoses are of precisely the same nature as those above described.

If left to themselves these tumours as a rule cease to grow at the age when the epiphyses become ossified, for being a part of the epiphyses they follow the laws regulating its development and growth; they are painless, increase in size very slowly, and unless in the close vicinity of a joint cause the patient little if any inconvenience. Should they however implicate an articulation, desirable as it may be to remove the exostosis, you must be extremely cautious how you interfere, the more so as these small tumours when situated in the locality I have named are liable to be covered by elongated bursæ connected with the articular synovial membrane. On the other hand when the exostosis is well away from the joint, as in the instance of our little patient, and it has grown for a tumour of this description rather rapidly, it is well to excise it at once. After the removal of the tumour the surface of the epiphysis from which it has originated should be touched with carbolic acid or some other caustic so as to destroy the layer of cells in the vicinity, and thus if possible prevent the formation of a nodule of cartilage in the site of the former growth. I have seen two or three cases in which exostoses of this description have sprung from the cartilage of the distal phalanx of the great toe, independently of the pressure of tight shoes, for these patients had never been accustomed to wear any shoes at all, but they referred the growth of the tumours to an accident. And it is remarkable that the only other toe on which these exostoses have been met with is the little one, which, like the great toe, is very liable to external injuries. These cartilaginous tumours of the phalanges give rise to great pain and inconvenience, for as they increase in size they press on the root and sides of the toe-nail, producing ulceration of the part and displacing the nail to a greater or less extent.

The best treatment to adopt in cases of the kind is to remove the phalanx together with the tumour, although it may be possible to extirpate the exostosis by incision through the soft parts and the use of the cutting pliers.

IVORY EXOSTOSIS.

We have had the opportunity on several occasions of seeing a patient in the Chadwick ward, suffering from an exostosis over the right superciliary ridge.

R. P., æt. thirty-one, states that eighteen years ago he sustained a heavy fall which stunned him at the time. He believes from the position in which he fell that he must have struck his forehead, but there was no contusion or external injury of the part. Some three years subsequent to this accident he noticed a swelling over the right eyebrow, it gradually increased in size, reaching its present dimensions in about three and a half years, without causing him any pain, but he then began to suffer from epileptic fits which have been extremely severe and repeated as often as three or four times a day. Under the influence of bromide of potassium these fits have lately diminished in number, but he finds his memory impaired and he has become extremely weak, effects not uncommonly experienced among persons after a long-continued course of bromide of potassium.

At present, occupying the position of the right frontal eminence, there is a smooth bony tumour three inches in diameter growing from the frontal bone, its surface is uniformly convex and even, and the skin moves freely over it.

From the occurrence of epileptic fits in this case it is probable that a similar bony growth to that above described, projects from the inner surface of the skull, a condition of things not unfrequently met with in cases of ivory exostosis.

As a rule these ivory exostoses grow from some part of the skull, their favourite site being over the superciliary ridge and the orbital plate of the frontal bone; they have occasionally been met with springing from the jaws and the external auditory meatus, also from some of the flat bones of the skeleton. They increase in bulk very slowly, and seldom reach any great size, though there are exceptions to this rule. They cause no pain unless they press upon nerves, and are inconvenient rather than dangerous, except when they happen to encroach upon the brain or some vital organ, as in the case above referred to. I have never had the opportunity of examining a recently injected specimen of this form of tumour, and I am unable to form an opinion as to their anatomy.

With reference to the treatment of these ivory exostoses, if growing from the skull; supposing we could remove a growth of the kind by means of the knife and the chisel—an attempt which has failed more than once in consequence of their extreme hardness—we might subsequently discover that we had only got rid of a portion, and that by far the least harmful part of the tumour; in fact I can repeat with confidence to you the injunction (if you are consulted with reference to a case of ivory exostosis of the skull) to leave it alone.

Mr. G. F. Field has lately recorded a case of ivory exostosis filling the auditory meatus on each side, in which he managed to bore through the small tumours, and so opened a passage down to the tympanum.

Instances of ivory exostosis, originating in the antrum of the maxillary bones, are by no means common, but are nevertheless met with from time to time, and have been removed with success, in one case after an operation lasting three hours.

In recent works on pathological anatomy we find accounts of what are called spongy exostosis, most commonly springing from the superior maxilla and sometimes from other bones of the skeleton. I cannot of course deny the existence of these exostoses, but I expect instances of the kind are rare, if we exclude (as we have every right to do) cases of syphilitic, sarcomatous, and enchondromatous disease of the bone from our consideration. Nor is it possible, as I have remarked, to form an idea of the real nature of these outgrowths of bone from an examination of dried specimens; under these circumstances we may see a coral-like mass springing from the antrum and projecting outwards, but in the living subject the interstices of this hard growth was filled with perhaps a sarcomatous formation. Unless we have opportunities of inspecting these tumours in a recent state, it is difficult to say to what class they belong. There can be no question that the majority of bony tumours formerly described as fibro-cellular are now designated osteo-sarcoma, such as I described to you in my last lecture. At the same time I have seen undoubted exostosis growing from both the upper and the lower jaw, but in no instance did it greatly interfere with the comfort or health of the patient, and therefore I advised that it should be left alone. This rule does not always apply to exostosis connected with the long bones. We have had an instance in point lately in the hospital; the notes of the case were carefully kept for me by Mr. Munyard.

C. M., æt. twenty-eight, was sent into the hospital by Dr. Ferris of Uxbridge. It appears this patient, when ten years of age, was thrown and kicked by a horse on the right thigh. For a month after the accident the injured part was bruised and swollen; subsequently a hard lump formed at the site of injury, which gradually increased to its present size. This tumour of the thigh has caused the patient very little pain or inconvenience, and for some years past has not perceptibly increased in bulk.

On admission we found a dense exostosis situated on the inner side of the patient's right thigh, four and a half inches from the internal tuberosity of the femur, on the line of the femoral artery; it was about four inches long and five broad, and was firmly attached by a broad base to the femur.

I declined operating in this case, because the tumour was simply an inconvenience to the patient. He was able to carry on his business without pain or trouble, and, as I told the class, we had no right whatever to subject a patient to the risk of an operation, which, under existing circumstances, was not absolutely necessary. I have little doubt that in removing this exostosis we should have exposed a large surface of the femur, and in all probability have opened the medullary canal, and run the risk of osteo-myelitis; on the other hand, it is very probable the tumour will not increase in size, but if it does, and interferes with the patient performing his duties, we should be justified in recommending its removal, provided we had the patient's consent to amputate the thigh if we could not take away the tumour without the limb.

CYSTIC TUMOURS OF BONE.

These may be mentioned with reference to morbid growths connected with the jaws, for, with the exception of a few instances of hydatid cystic disease in the extremities of the long bones, I am not aware that cysts, in the ordinary sense of the term, have been found in any bones excepting the maxillæ. The late Mr. Tomes studied this subject with great care; he observed during the development of the teeth that the enamel is separated from the surrounding soft parts by a small quantity of serous fluid, which under ordinary circumstances escapes when the tooth is cut, but it occasionally happens that the tooth remains impacted in the bone, and then the fluid surrounding it increases in quantity, the tissues inclosing it augment in density, and so a cyst or bag of fluid forms in the substance of the bone. A fault of this kind may occur from the fact of a tooth being originally too deeply developed in the body of the jaw, so that it never reaches the surface, or the development of the tooth may be arrested before it is cut; lastly, a tooth before reaching the surface of the alveolus may become misdirected in its growth, and thus never reach the edge of the gum.

Faults of this description rarely occur to the first set of teeth, and are more often met with in connection with the upper permanent canine than any other tooth; the dens sapientiæ, however, as well as the other teeth, have from time to time been found impacted in either the upper or lower jaws in the manner above described. I think the youngest case of the sort on record is that of a girl aged thirteen years, one of her lateral incisors being imbedded in the inter-maxillary bone above, and behind the root of the central incisor. Probably the oldest patient affected in this way was a man sixty years of age. He suffered from a tumour the size of a pigeon's egg in his upper jaw which for many months closed the nostril of that side. It was caused by the expansion of a cyst round the second pre-molar which was impacted deep in the substance of the jaw.

In the majority of these cases the patient has suffered from a slowly increasing, almost painless tumour which may grow to a very considerable size, and which is evidently connected with one or other of the maxillary bones. The soft structures covering the tumour are usually in a normal condition, or it is possible the cyst may have burst and a fistulous opening formed leading into a cavity in the bone. We shall generally discover that one of the permanent teeth is wanting and has never made its appearance in its proper position. On manipulation we readily perceive that the tumour is due to an expansion of the bone, and we may be able to detect fluid in it; its walls are perhaps so thin as to be elastic and are indented on pressure, bulging out again to their former shape with a peculiar crepitation when the pressure is removed. But in a case of the kind I had under my care a few months since the tumour felt almost solid to the touch, and neither fluctuation nor crepitation could be felt on manipulation, but there was the history of a slowly increasing painless tumour expanding the anterior part of the lower jaw to the size of a hen's egg, the left canine tooth was absent—it had not been extracted; being however in doubt as to the nature of the growth, I pierced the walls of the tumour and let out a small quantity of fluid, I then freely opened the cyst.

If in doubt in a case of this kind it will of course be necessary to make an exploratory opening before proceeding to further treatment. Supposing we have formed our diagnosis and come to the conclusion that we have to deal with a dentigerous cyst, our object will be to remove the enclosed tooth, and then the cavity in which it was contained will gradually close.

It is seldom a case of the kind may not be cured without injuring the cheek. The walls of the cyst should be cut through with a scalpel, bone-pliers, or if necessary with a saw. The cyst having been freely opened its contents must be removed, after which the cavity should be plugged with lint, the dressing being changed from time to time until the jaw contracts, and the disease is thus cured. In the case above referred to this plan was adopted and the patient made an excellent recovery, although it took nearly three months for the jaw to return to its present size, which is hardly larger than it would have been in the normal condition.

There are a few instances on record in which cysts containing a supernumerary tooth have been found in the antrum of the superior maxillary bone. It is well that you should be aware of the fact that cystic tumours in this locality have arisen from this cause, but cases of the kind are so rarely met with that they belong rather to the domain of the curiosities of pathological anatomy than to that of clinical surgery.

Hydatid cysts, as I have already remarked, are occasionally found in the cancellated tissue of bones. Cysts of this kind gradually expand the osseous structures in which they grow, causing the patient but slight pain, and slowly increasing in size; the tumour sometimes communicates to the fingers when pressure is made upon it the peculiar crackling sensation belonging to osseous cysts with their walls. In a case reported by Mr. Keats, in which the hydatid cyst formed between the table of the frontal bone, the osseous walls were so dense that they were not indented by pressure. The nature of the growth can only be determined by opening the cyst. Under any circumstances, tumours of this description should be treated in the same way as dentigerous cysts, their contents must be evacuated, and the cavity in the bone painted over with a 40 per cent. solution of carbolic acid, and then filled with lint, so as to excite suppuration and destruction of the walls of the cyst, after which we may fairly hope that the cavity in the bone will be filled up with new osseous tissue.

VASCULAR TUMOURS OF BONE.

Mr. Stanley and other authorities have described vascular tumours of bone under two heads, "cystic-blood tumours" and "pulsatile vascular tumours of bone." The more closely however we examine specimens of the kind and the histories of the cases from which they were taken, combined with one's own experience on the subject, the clearer it becomes that the morbid appearances referred to are, as a rule, the result of pre-existing disease, either myeloid or malignant. In fact we know perfectly well that sarcomatous growths, especially in the myeloid form, are very apt to degenerate into cyst-like cavities which become filled with blood, forming in truth blood-cysts. The importance of bearing this fact in mind is obvious, because if we were to treat a tumour of the kind in the manner described for the cure of dentigerous cysts, the chances are, the sarcomatous growth being stimulated into increased action, would grow very much more rapidly than if we had left it alone. So that if you meet with a tumour of bone, other than those connected with the upper and lower jaw, which is supposed to be cystic in its nature, and on cutting into it you find that it contains blood and soft gelatinous material, you may, I think, presume that you have a myeloid, if not a malignant growth to deal with, and you must manage it accordingly.

Although the origin of blood cysts connected with bone is generally such as I have described, nevertheless we must bear in mind the fact, that after an injury blood may be effused into the periosteal tissue or into the cancellated tissue of a bone and form a hæmatoma. As an example, we may instance what sometimes occurs in parturition from pressure of the fœtal head during its passage through the pelvis. The vessels beneath the pericranium are ruptured, and a large soft elastic swelling may be found on the child's head at the time of birth, over one of the parietal bones. The pressure of this clot may interfere with the process of ossification of the bone beneath it, and at the line of separation of the pericranium from the skull a ridge of bone is sometimes produced, resembling in its nature a provisional callus. As the clot becomes absorbed the rim of newly formed soft bone remains, giving one the impression that there is a hole in the skull occupying the space formerly covered by the clot; this condition does not arise from a depression in the bone, but from an osseous ridge produced in the manner I have described. In the course of time the laws governing the symmetrical growth of the body gain the supremacy, and the new bone ultimately disappears like the provisional callus.

With reference to the second class of vascular tumours of the bone, we have even less hesitation than in the case of cystic tumours in pronouncing them to be due to sarcomatous or carcinomatous disease. Tumours of this kind are often extremely vascular, and, if situated near one of the large vessels, they are apt to pulsate in a remarkable manner. On applying the stethoscope to the part a well-marked bruit may sometimes be heard, so as to lead to the impression that the tumour is due to an aneurism.

One of the most remarkable cases of this kind I ever met with occurred in the instance of a patient who had, on her voyage from India, fallen and struck the lower part of her back against a box. Some three months after the accident she began to complain of severe pain in the left gluteal region, supposed at the time to be due to sciatica. When I saw her two months after the commencement of the pain, there was some fulness over the gluteal region; but it was not until a month later that the swelling became very apparent, and a distinct pulsation could then be felt in the part, and on applying a stethoscope over the swelling a bruit was audible. The late Sir W. Fergusson subsequently saw the case with me, and we arrived at the conclusion that the symptoms were due to a malignant growth originating in the dorsum illii. He related the circumstances of a patient formerly in King's College Hospital, which resembled the condition presented by this person in a very remarkable manner.

This case illustrates the clinical history of the majority of pulsating tumours of bone which we meet with in practice. They are not always so obscure in the early stages of the disease as this was in consequence of the thick covering of soft tissues which intervene between the tumour and the surface of the body, and we must bear in mind that pulsating tumours originating in bone may be myeloid in their nature, but, if so, would hardly be met with except in connection with the cancellated structures occupying the extremities of the long bones. It is probable that the favourable results occasionally reported after tying the brachial and femoral arteries for the cure of pulsating tumours of the radius, and head of the tibia, were in truth instances of myeloid disease in these localities. We can hardly mistake, however, a malignant for a slowly growing sarcomatous affection, if we watch the case for a few months. The rapid growth of the former, and the development of the cancerous cachexia, lead us to the conviction that we have a malignant and not a sarcomatous disease to deal with. Nevertheless, the border-line between these morbid growths is anything but a hard and fast one, and in the earlier stages of these tumours it will require our utmost care and attention to arrive at a correct diagnosis. The following is an instance in point, "in which a pulsating tumour originated in the shaft of the femur, at the part where the bone had been twice broken. The opinion being entertained that the tumour was aneurismal, the femoral artery was tied, and the tumour became somewhat diminished. About a month afterwards, it again enlarged, and the limb was then amputated. The lower third of the femur was found expanded into a spherical tumour, in the interior of which were cells of various size, filled with blood."—*Stanley.*

MALIGNANT DISEASE OF BONE.

We have now arrived at the question as to the existence of primary cancer in the osseous tissues, and we may probably best keep clear of the difficulties surrounding this problem by considering the subject from a clinical rather than a pathological point of view.

No doubt our ideas regarding cell-formations have undergone considerable modifications within the last few years. Formerly the spindle-shaped cell with its bright nucleus, when surrounded by a certain amount of fibrous structure, was supposed to be characteristic of malignant tumours. On the other hand, it is now maintained by some authorities, that we cannot depend on the appearances presented by any specimen as determining the nature of the growth from which it was taken, and that the only real difference between malignant and non-malignant tumours is the rapidity with which the former grows as compared with the latter; that it is the intensity of action contained in such a growth as a carcinoma, for instance, which renders its elements capable of imparting the morbid action to indifferent living organic matter brought by the blood into the diseased area. It is argued that all the tissues of the body were originally formed from a few embryonic cells which precisely resemble one another in appearance, and conversely that the descendants of these cells may therefore replace one another in the various structures composing the body, so that a cartilage cell, if liberated from its hyaline matrix, might assume the form and functions of a white blood corpuscule. Admitting, however, the fact that the primary cells from which the embryo is formed are similar in appearance as seen under the microscope, it is nevertheless certain that these cells have received an individual or characteristic impression or force which governs their future destinies, and lasts so long as the cell lives, and which it is able to propagate to its descendants. I conceive a cartilage cell remains such so long as it is placed under favourable circumstances, and is derived from healthy antecedents, and that throughout its natural life it can only perform definite functions in the body. These cells, within certain limits, may, it is true, produce structures slightly different from cartilage, depending upon some peculiarities in their surroundings, or it may be from inherent defects. Nevertheless any such deviations from the natural functions of the cell are extremely limited. It seems to me, however, quite within the bounds of reasonable speculation to presume that a combination of two or more cells in the body may occur, resulting in a compound cell inheriting the properties of the parent cells, although differing from both of them in its combined action. Upon this idea I attempted to explain the formation of the round cells of the medulla of bone, and the myeloid cells of this locality are simply a conglomeration of the nuclei of the embryonic cartilage cells.

When speaking of osteo-sarcoma I gave expression to the opinion of most authorities on the subject that the myeloid tumours of bone are of an innocent nature. They may and often do grow from more than one part of the body, but this is just as probably due to an inherent fault of the cells of the part from which they sprung, as it is to the original tumour having the power to stimulate organic matter passing through it into similar morbid action, the diseased cells passing away and forming other tumours in distant parts of the body. No doubt when these tumours have softened down portions of them might be carried by the blood to various other structures, but I think if such were the ordinary course of the diseased action we should more frequently meet with secondary sarcomatous tumours than we do under existing circumstances.

The tendency of malignant disease is to be transmitted through hereditary influences. Whatever may be the combination of causes which develop the formation of cancer in a person born with a disposition to the disease, it spreads from the primary focus either by continuity of growth along the lymphatics, or it may be by mere contact-influence, the living matter passing through the cancerous formation receiving an abnormal impression, which it conveys to other living matter. Whichever of these ideas we adopt, the broad fact remains, the characteristic feature of malignant disease is its infectious nature, and every surgeon knows that tumours, having in a marked degree these characteristics, do at times originate in the cancellated tissue of bone.

I have already referred to a case of malignant disease growing from the dorsum ilii (page 279). In this instance, the patient died within sixteen months of the date on which I first saw her. The lungs and liver were both infiltrated with malignant growths. The original tumour had replaced the greater part of the ilium, was extremely vascular, and presented the characters of a medullary carcinoma.

I saw another instance of somewhat the same kind with my colleague, Mr. Keen, a short time since. His patient was an elderly lady, who had no history of cancer or other hereditary form of disease. Without any assignable cause, some six months ago, a swelling was noticed beneath the left eye, extending down the cheek, it increased rather rapidly in size, and was attended with sharp cutting pain. The eye-ball was forced upwards and inwards, and when I saw her the skin over the most prominent part of the morbid growth had already become incorporated into the tumour, the parotid gland was enlarged, and the vessels coursing over the tumour engorged with blood. The morbid growth was soft on pressure, and evidently firmly attached to the bone beneath. From the rapid growth, pain, enlargement of the neighbouring glands, and the implication of the skin with the tumour, together with the sallow anæmic look of the patient, we arrived at the conclusion that the tumour was of a malignant nature.

The cancerous cachexia, however, is frequently not developed until a much later stage of the malady than it was in this particular case; it often happens that, in the earlier periods of cancerous affections, the patient's general appearance is unaltered; but it is remarkable that a person suffering from the incipient manifestation of malignant disease invariably loses weight rapidly. The scales, in fact, in such cases might almost be employed as advantageously as the thermometer is in certain forms of disease; and it is in these early stages of cancer that we so much require all the means at our command to enable us to form an accurate diagnosis. As the malady advances and the malignant cachexia is thoroughly developed, it is more than probable that the tumour we have to deal with will have unmistakeably declared its nature.

For instance, a patient may consult us for an enlargement of the upper end of the tibia, with perhaps a fixed pain in this locality. It appears that the head of the bone is enlarged; in such a case, the first point to be considered is the history of the patient, by learning all the particulars connected with his previous circumstances; examining the state of his teeth and so on, we may eliminate syphilitic affections of the bone from our consideration. Tuberculous disease is not characterised by enlargement of the bones, and is most frequently found among young people with a scrofulous diathesis. The pain from an abcess, or even from an hydatid cyst in the head of the bone, would be a chronic affection, and in its early stages there would be only slight, if any, enlargement of the head of the tibia. So that, in all probability, the case under consideration depends on a morbid growth of some kind or other originating in the cancellated tissue of the head of the bone, but I should certainly decline giving an opinion as to the nature of the disease until I had watched its progress for a time. If, after two or three months, the disease was still localized, and the head of the tibia had increased considerably in size, and the patient was suffering from intense pain, the glands in the groin and popliteal space being enlarged, and that he had lost flesh rapidly, I should incline strongly to the opinion that this was a malignant disease. This idea would be strengthened if the tumour pulsated, and would be rendered almost certain if there were a family history pointing to cancer, a history, let me remark, which the most truthful patient and his friends will frequently conceal from you, and which is only arrived at by careful cross-examination.

In an instance such as I have supposed, I should strongly advise patience, and no expression of opinion, unless it can be given with the strength of a confirmed idea on the subject. My reasoning on the matter would be somewhat as follows:—

If this tumour is an osteo-sarcoma, or, in fact, any non-malignant form of growth, it can do no very great harm to wait until it has fully developed its characteristic features, and enabled us to pronounce a positive opinion as to its nature. We should then be in a position to insist upon the only treatment which could be of any avail, for being unable to excise the growth, an amputation at the knee-joint (although the flaps of skin might partly have to be formed of the integuments covering the tumours) would be the correct treatment to adopt.

Supposing, however, the tumour continued to grow rapidly, and the other symptoms characteristic of malignant disease manifested themselves, we should, I believe, have done no harm in postponing our opinion as to the nature of the affection, because when we make up our mind that it is a malignant tumour *of one of the bones of the leg or the femur* we have to deal with, it will be right to explain the nature of the malady to the patient, and affirm our inability to stay its progress; for it is my conviction that an amputation of the leg should not be undertaken in a case of this kind. I would simply ask the question, Has an amputation of the thigh for malignant disease of the leg ever prevented the disease from springing up in another part of the body within a very short time after the operation? But it may be argued, life is prolonged by means of an operation. I hardly think, however, this is correct if we take the aggregate of cases of the kind operated on. What I mean is, if the entire number of days patients have lived after amputation for malignant disease of the bones were added together, the total number would amount to a smaller sum than if the patients had not been operated on. It is often said you cannot leave a patient and tell him it is impossible to do anything more for him; give him at any rate the hope of life if he is willing to undergo the risk of an operation. My own experience is opposed to this reasoning. Having come to the conclusion that the case is a hopeless one, I feel that it is not only right, but the kindest thing we can do, to lay the facts plainly before the patient; those whom we frequently suppose to be timid, under these circumstances evince the greatest fortitude; in truth, human beings are so constituted that it is more satisfactory for them to be able to rest on a certainty, however terrible that may be, than to exist in a state of doubt as to what may be in store for them. You will constantly be urged by over-kind relatives and friends to conceal the truth regarding the absolutely fatal nature of the disease from your patient, and of course your own feelings, no less than your inclination, would prevent you from forcing the subject; but when asked by the patient as to the nature of his disease, never consent, either in cases of this kind or unaer any circumstances, to tell him what is not strictly true, especially when you have to deal with a disease such as the one we have been considering. We have as yet discovered no cure for cancer. In my opinion we have no right to subject a patient suffering from a form of it, such as I have referred to, to an operation, and if this principle were confirmed, it might possibly be the means of leading surgeons to consider more attentively other means of treatment for the relief of this fearful disease.

You will clearly understand that these remarks apply to cases of malignant disease affecting the bones of the leg, for, as I shall have to explain to you on another occasion, in the early stages of carcinoma of the breast we do not hesitate to excise the tumour, together with the skin covering it, and the whole of the surrounding tissues, including the lymphatics in the axilla. In this way we may hope to prevent the recurrence of the disease in the locality from which it has been removed. Excision of carcinomatous growths in their early stages is in fact a perfectly legitimate practice if the disease commences in the glandular structures, and we might very probably be inclined to amputate the arm for carcinoma affecting the bones of the forearm, or even the lower end of the humerus; but we cannot overlook the fact that the prognosis in cases of malignant disease originating in the osseous tissues is always an extremely bad one, even more so than when it commences in some other parts of the body.

With reference to the growth of secondary cancer in bone, or the infiltration of the medulla with cancer-cells, the result of malignant disease in other localities, there can be no question as to the frequency of this occurrence; for instance, we see epithelioma of the face propagated to the jawbones, or an epithelioma of the leg to the tibia, setting up a kind of cancerous caries in these bones. What happens is this: cylinders of cancer-cells are protruded into the vascular pores of the bone, and then they spread and grow. You have seen cases from time to time in which the medulla of many of the bones forming the skeleton has become infiltrated with cancer-cells, and so the integrity of the hard osseous tissue has become soft and yielding to muscular pressure or the weight of the body; the bone has become bent and misshapen, as I described to you in speaking of mollities-ossium (page 225); but this condition in cases of cancer is always the result, or at any rate apparently follows the development, of malignant disease in other parts of the body, and it is doubtless a modified form of this cancerous infiltration of the medulla which produces the tendency to fracture of the bones, sometimes met with in persons suffering from malignant disease.

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